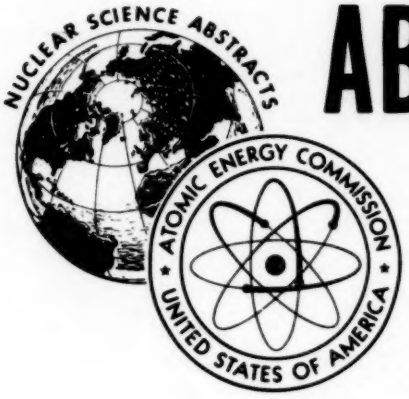
NUCLEAR SCIENCE ABSTRACTS



Volume 30 Number 3

Abstracts 5836-9026

August 15, 1974

UNITED STATES ATOMIC ENERGY COMMISSION

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of USAEC and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, AEC's Technical Progress Reviews, AEC-sponsored translations, conference proceedings published by AEC, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

Report collections of USAEC reports in countries other than the United States are listed on the inside back cover.

ALABAMA
Auburn, Auburn University
Tuskegee Institute, Tuskegee Institute

ALASKA
College, University of Alaska

ARIZONA
Tucson, University of Arizona

CALIFORNIA
Davis, University of California
Los Angeles, University of California
Santa Barbara, University of California

COLORADO
Boulder, University of Colorado

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

IDAHO
Pocatello, Idaho State University

ILLINOIS
Urbana, University of Illinois

INDIANA
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Massachusetts Institute of Technology
Worcester, Worcester Polytechnic Institute

MICHIGAN
Ann Arbor, University of Michigan

MISSISSIPPI
State College, Mississippi State University

MISSOURI
Columbia, University of Missouri
Kansas City, Linda Hall Library

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Albany, New York State Library
Albany, State University at Albany
Ithaca, Cornell University
New York, Columbia University
Rochester, University of Rochester
Syracuse, Syracuse University
Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
Raleigh, North Carolina State University

OHIO
Cincinnati, University of Cincinnati
Cleveland, Cleveland Public Library

OHIO (Continued)
Columbus, Ohio State University
Toledo, University of Toledo

OKLAHOMA
Norman, University of Oklahoma

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
San Juan, University of Puerto Rico

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee

TEXAS
Austin, University of Texas
College Station, Texas A & M University
Houston, Rice University

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin

USAEC reports so indicated in *Nuclear Science Abstracts* are offered for sale by National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22151.

Volume 30, Number 3, August 15, 1974

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services
Published by the USAEC Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the USAEC Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

Atomic Energy of Canada Limited
Australian Atomic Energy Commission
Danish Atomic Energy Commission
Finnish Atomic Energy Commission
French Atomic Energy Commission
Japan Atomic Energy Bureau–Atomic Energy Research Institute
Commissie Nucleaire Informatieverzorging (Netherlands)
Institutt for Atomenergi (Norway)
Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority
Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

NSA is issued in two volumes per calendar year, one beginning January 15, the other July 15. Each volume consists of twelve issues.

For the two 12-issue volumes, the annual subscription rate is $75.50 for domestic subscribers and $94.50 for foreign subscribers. A single issue costs $3.25 domestic rates or $4.07 foreign rates. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, Guyana, French Guiana, Surinam, and British Honduras.

Indexes are cumulated for each volume, i.e., on a six-month volume basis. Each volume index is priced at $35.70 for domestic subscribers and $45.10 for foreign subscribers.

Previous *NSA* cumulative indexes are available:

From Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003:

Vols. 1–4, Subjects and Authors (1948–1950), $30.00.

From Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830:

Vols. 5–10, Subjects and Authors (1951–1956), $5.25.

Vols. 11–15, Subjects (1957–1961), $19.00.
Vols. 11–15, Personal Authors (1957–1961), $14.25.
Vols. 11–15, Corporate Authors (1957–1961), $2.50.

From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:

Vols. 16–20, Subjects (1962–1966), $36.00.
Vols. 16–20, Personal Authors (1962–1966), $22.50.
Vols. 16–20, Corporate Authors (1962–1966), $3.75.

Vol. 26, Subjects and Authors (1972), $37.75.

Vol. 27, Subjects, Authors, and Report Numbers (Jan.–June 1973), $16.90.

Vol. 28, Subjects and Authors (July–Dec. 1973), $18.55.

Cumulative Report Number Index, Vols. 1–15 Revised, $4.00.
Cumulative Report Number Index, Vols. 16–20 Revised, $5.50.
Cumulative Report Number Index, Vols. 21–28, $9.35.

From Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106:

Vols. 21–25, Subjects, Authors, and Corporate Authors (1967–1971), $195.00.

Nuclear Science Abstracts is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Government agencies may obtain *NSA* free of charge. Inquiries should be directed to the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Nuclear Science Abstracts is also available on 16-mm and 35-mm microfilm in reel or cartridge from Princeton Microfilm Corporation, Alexander Road, Princeton, New Jersey 08540. The cost of Vols. 1–26 (1948–1972) including *Abstracts of Declassified Documents* (1947–1948) is $730.00. The indexes for *Nuclear Science Abstracts* Vols. 1–26 (1948–1972) are also available for $385.00. The cost of each volume (six months) of *NSA* and its indexes is $45.

INDEXES TO NSA

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multi-volume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SMITH, H., Planetary nebulae: two types, 29:13374
SMITH, H.R. Jr., Principles of electron beam technology, 29:13155
SMITH, J., See HOEGERMAN, S.F., 29:13035
See HOEGERMAN, S.F., 29:13037

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTOR LICENSING/SPAIN
Harmonization of the licensing conditions including environmental protection for the siting of nuclear power plants, 29:14745
REACTOR MATERIALS/STRESS ANALYSIS
Problems on nuclear reactor structure at elevated temperature, 29:14654
REACTOR PROTECTION SYSTEMS
HTGR gas turbine power plant control and safety studies. Quarterly progress report for the period July 1, 1973--September 30, 1973, 29:14846 (GULF-GA-A-12799)

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

14452 (WASH-1278) CTR ENGINEERING SYSTEMS STUDY REVIEW MEETING, GERMANTOWN, MARYLAND, SEPTEMBER 19 AND 20, 1973. Gough, W. C. **(USAEC Division of Controlled Thermonuclear Research, Washington, D. C.).** 1973. 258p. (CONF-730971-). Dep. NTIS $7.60.

is indexed as:

USAEC DIVISION OF CONTROLLED THERMONUCLEAR RESEARCH, WASHINGTON, D.C.
CTR engineering systems study review meeting, Germantown, Maryland, September 19 and 20, 1973, 29:14452 (WASH-1278)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

WANL-M-FR-	**(Non-AEC)**	
72-5	29-13170	See N-73-31498
73-2	29-13070	See N-73-27584
WAPD-TM-	**(Misc.)**	
1126	29-14648	Dep. NTIS, $3.00
WARD-RR-		
3045-3	29-14647	AT
WARD-XS-		
3045-4	29-14784	AT
WASH-		
1208(12-73)	29-14582	Dep. NTIS, $3.00
1271	29-14451	Dep. NTIS, $7.60
1273	29-13005	NTIS, $4.00
1278	29-14452	Dep. NTIS, $7.60
1283	29-15003	Dep. NTIS, $7.50
WCAP-	**(Misc.)**	
7757	29-14785	
7758	29-14786	

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 30, Number 3, August 15, 1974

Category	Page
CHEMISTRY	585
Analytical and Separations Chemistry	585
Activation and Nuclear Reaction Procedures	585
Chemical and Spectral Procedures	591
Radiometric and Radiochemical Procedures	596
Separation Procedures	599
Inorganic, Organic, and Physical Chemistry	602
Chemical and Physicochemical Properties	602
Isotope Effects	603
Isotope Exchange and Isotope Separation	605
Feed Materials Processing	606
Radiation Chemistry	606
Radiochemistry and Nuclear Chemistry	612
Hot-Atom Chemistry	612
Properties of Radioactive Materials	613
Radioactive Waste Treatment	618
Radioisotope Production	619
Reactor Fuel Reprocessing	620
CONTROLLED THERMONUCLEAR RESEARCH	622
Confinement and Heating	622
Diagnostics	623
Kinetics (General)	626
Kinetics (Experimental)	627
Kinetics (Theoretical)	627
Production	628
Stability	630
Thermonuclear Engineering and Equipment	631
Wave Phenomena	635
ENGINEERING	638
Energy Conversion	638
Facilities and Equipment	639
Heat Transfer and Fluid Flow	648
Materials Testing	649
Nuclear Explosions	649
Protective Structures and Equipment	650
Vacuum Engineering	650
ENVIRONMENTAL AND EARTH SCIENCES	651
Minerals and Ores	651
Radioactive Effluents	651
Radioactivity Monitoring and Transport	652
Atmosphere	654
Soil	655
Water	657
Ecosystems and Food Cycles	658
Radiometric Techniques	659
Site Surveys	661
Thermal Effluents	662
Chemical Effluents	663
INSTRUMENTATION	665
Radiation Detection Instruments	665
General Detectors and Monitors	665
Radiation Dosimeters	675

Category	Page
INSTRUMENTATION (Cont'd.)	
Nuclear Spectroscopic Instrumentation	677
High Energy Physics Instrumentation	679
Radiometric Instruments	681
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	682
Miscellaneous Instruments	682
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	686
Isotope Separation (Industrial)	686
Isotopic Power Sources	686
Radiation Sources	686
Design and Fabrication	686
Industrial Uses	687
LIFE SCIENCES	688
Radiation Effects on Biochemicals	688
Radiation Effects on Cells	690
Radiation Effects on Microorganisms	691
Radiation Effects on Plants	693
Radiation Effects on Animals	695
Man	695
Vertebrates	701
Invertebrates	719
Radionuclide Effects (Internal Source)	720
Man	720
Animals	720
Plants	722
Microorganisms	722
Nuclide Kinetics and Toxicology	722
Man	722
Animals	723
Plants	725
Microorganisms	725
New Tracer Techniques	726
MATERIALS	730
Ceramics and Cermets	733
Metals and Alloys	738
Corrosion and Erosion	739
Preparation and Fabrication	741
Properties, Structure, and Phase Studies	742
Radiation Effects	751
Other Materials	754
NUCLEAR MATERIALS AND WASTE MANAGEMENT	757
Accountability and Safeguards	757
Disposal and Storage	757
Handling Equipment and Procedures	758
Transportation	759
PARTICLE ACCELERATORS	760
Design, Development, and Operation	760
Auxiliaries and Components	761
Ion Sources and Injection and Extraction Systems	762
Ion Optics and Field Calculations	763
Storage Rings	764
Experimental Facilities	764

TABLE OF CONTENTS (continued)

Category	Page
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	767
Cosmic Radiation	767
Stars	768
Quasi-Stellar, Radio, and X-Ray Sources	777
Solar Phenomena	783
Galaxies	788
Cosmology	792
Planetary Phenomena	794
PHYSICS (ATMOSPHERIC)	796
Auroral and Ionospheric Phenomena	796
Magnetospheric Phenomena	798
PHYSICS (ATOMIC AND MOLECULAR)	801
Beams and Their Reactions	801
Atomic and Molecular Properties	802
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	804
Collision Phenomena	804
Atomic Theory	810
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	812
PHYSICS (HIGH-ENERGY)	813
Particle Interactions and Properties (Experimental)	813
Electromagnetic	813
Weak	814
Strong (Baryon-induced)	814
Strong (Meson-induced)	817
Particle Interactions and Properties (Theoretical)	820
General	820
Electromagnetic	821
Weak	825
Strong (General)	825
Strong (Baryon No. = 0)	826
Strong (Baryon No. = 1)	827
Strong (Baryon No. ⩾ 2)	829
Particle Invariance Principles and Symmetries	830
General	830
Applications (Electromagnetic and Weak)	831
Applications (Strong)	831
Scattering Theory	831
PHYSICS (LOW-TEMPERATURE)	834
Superfluidity	834
Superconductivity	835
Equipment and Devices	838
PHYSICS (NUCLEAR)	840
Neutron Interactions with Matter	840
Nuclear Properties and Reactions, A ⩽ 5	840
Nuclear Properties and Reactions, 6 ⩽ A ⩽ 19	842
Nuclear Properties and Reactions, 20 ⩽ A ⩽ 38	846
Nuclear Properties and Reactions, 39 ⩽ A ⩽ 58	847

Category	Page
PHYSICS (NUCLEAR) (Cont'd.)	
Nuclear Properties and Reactions, 59 ⩽ A ⩽ 89	849
Nuclear Properties and Reactions, 90 ⩽ A ⩽ 149	850
Nuclear Properties and Reactions, 150 ⩽ A ⩽ 189	852
Nuclear Properties and Reactions, 190 ⩽ A ⩽ 219	853
Nuclear Properties and Reactions, A ⩾ 220	854
Nuclear Theory	856
PHYSICS (RADIATION AND SHIELDING)	862
Radiation Physics	862
Radiation Source Calibration and Standardization	863
Shielding Calculations and Experiments	863
PHYSICS (THEORETICAL)	864
General	864
Quantum Field Theories	864
Gravitation and General Relativity	865
REACTOR TECHNOLOGY AND REGULATION	868
Power Reactors, Non-Breeding, BWR-Type	868
Power Reactors, Non-Breeding, PWR-Type	870
Power Reactors, Non-Breeding, Graphite Moderated	872
Power Reactors, Non-Breeding, Otherwise Moderated	873
Power Reactors, Breeding	875
Research, Test, and Experimental Reactors	878
Production and Materials Testing and Processing Reactors	880
Propulsion and Package Reactors	881
Reactor Safety and Environmental Aspects	884
Reactor Theory and Calculation	890
Reactor Components and Accessories	891
Reactor Fuels	899
Reactor Control Systems	900
Nuclear Power Plant Economics	902
Reactor Fuel Cycle Economics	903
Reactor Licensing and Regulation	903
GENERAL	905
Energy Utilization and Economics	905
Information Handling	905
Law	905
Management	905
Mathematics and Computers	905
Miscellaneous	907
Chemistry	908
Life Sciences	908
Materials	909
Physics and Engineering	909
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-10
SUBJECT INDEX	INDEX-66
REPORT NUMBER INDEX	INDEX-222

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Assistant Editor
Lee M. Thompson

Associate Editors
M. Catherine Grissom
Robert C. Kelly
Sidney F. Lanier
Henry D. Raleigh
Charles E. Stuber

Report Evaluators
John H. Mitchell
Mary H. Newman

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Dora H. Moneyhun

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Information Specialists
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Darrell O. Galde
Martha W. Gerrard
Everett J. Hoffman
Carolyn D. Houston
Lynda H. Kern
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Stanley J. Rimshaw
Jesse W. Rushing
Robert W. Rutkowski
Francis S. Sachs
Lila B. Smith
Polly C. Summers
Helen L. Ward
Lawrence T. Whitehead
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Noboru Kawakami

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 30, Number 3 August 15, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 6011, 6790, and 6791.

5836 (CONF-720660-(Absts.)) 31st CONGRESS OF THE GROUP FOR THE ADVANCEMENT OF PHYSICAL METHODS OF ANALYSIS, PARIS, FRANCE, JUNE 5–9, 1972. Abstracts. (Groupement pour l'Avancement des Methodes Spectroscopiques et Physico-Chimiques d'Analyse (GAMS), 75–Paris (France)). 1972. 57p. (In French and English).

Abstracts of the papers presented at the 31st Congress are compiled. They deal with new methods of analysis, development of new analytical equipment, and methods for processing analytical data. (JSR)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 6192, 7241, and 7503.

5837 (BARC/I-105) STUDY OF TRACE ELEMENT DISTRIBUTION IN INDIAN POTSHERDS BY NEUTRON ACTIVATION ANALYSIS. Iyer, R. K.; Jagannadha Rao, N.; Krishnamoorthy, K. B.; Sankar Das, M. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 10p. INIS.

The potsherds of Indian origin received as archaeological specimens are analyzed using neutron activation analysis. The specimens are classified into eight broad groups, based on their geological origin. The concentrations of five elements sodium, manganese, lanthanum, scandium, and chromium in the pottery specimens are determined. The concentration indices, the sum of the concentration indices, and the normalized concentration indices are employed to test whether a specimen belongs to a given group. The results indicate that specimens of each group must be well defined to minimize spread in the values with a group and afford clear distinction between specimens of different groups. (INIS)

5838 (F-592) IODINE CONTENT OF DRINKING WATER FROM VARIOUS PLACES IN NORWAY, ALSO IODINE CONTENT OF PRECIPITATION AT KJELLER AND IN BERGEN, WINTER AND SPRING 1973. Simensen, E. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Sep 1973. 12p. (In Norwegian). INIS.

Iodine in drinking water and precipitation has been measured by neutron activation techniques. Samples of water have been collected from water-works at 11 different places in Norway from September 1972 to April 1973. For all these samples the average concentration was 5.9 μgI/liter. Lowest and highest values were 4.5 and 6.7 μgI/liter. No seasonal variations were observed. From January 16 to March 12, 1973, the daily precipitation was collected at Kjeller. The average for 44 samples was 6.6 μgI/liter. The lowest and highest values in this period were 0.9 and 22.8 μgI/liter. Except for these and a third exceptional value there was very little variation from day to day. In the same period 15 days accumulated precipitation was obtained at Kjeller and Bergen. The average concentration for Kjeller was 6.1 μgI/liter, while the Bergen value was 5.5 μgI/liter. A method for measuring the iodine content by activation analysis without radiochemical separation is briefly described. (auth)

5839 (IEA-299) PROCESSING OF γ-SPECTRA IN ACTIVATION ANALYSIS WITH A PROGRAMABLE CALCULATOR. Garcia Agudo, E. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jul 1973. 31p. Dep. NTIS (US Sales Only) $4.75.

The use of a 9810-A Hewlett Packard programable calculator in activation analysis data processing is described. Three independent programs were developed: (a) Peak smoothing, area and standard deviation calculation, peak energy and statistical significance test; (b) Concentration calculations; and (c) Decay curve analysis. These programs are specially useful when the same elements must be measured in many samples. The longest program has only 884 program steps. Program listings, user's instructions, and examples have been included. (auth)

5840 DETERMINATION OF TRACES OF IRON, CHROMIUM, COBALT, AND ZINC IN VERY PURE SAMPLES OF AMMONIA, HYDROGEN PEROXIDE, AND MINERAL ACIDS BY NEUTRON ACTIVATION ANALYSIS. Ravnik, V.; Kosta, L. (Ljubljana Univ., Yugoslavia). Vestn. Slov. Kem. Drus.; 19: No. 1–4, 13-17(1972). (In French).

According to the proposed method the samples are evaporated to dryness in an apparatus, which permits a rapid and controlled evaporation in the irradiation ampules. Then the samples, with the standards, are irradiated for 180 to 200 hours in a flux of 2×10^{13} n/cm^2 sec. After preparation of the solution and the addition of carriers, the cobalt, iron, and zinc are fixed on the anion exchange resin in hydrochloric acid medium. The chromium, which passes through the column, is purified first by a double precipitation of the hydroxides and finally by oxidation of chromium with hydrogen peroxide in alkaline medium. The elements fixed on the column are desorbed by hydrochloric acid at different concentrations. The chemical yield for cobalt, iron, and zinc is 95–98%. The separation for chromium is not quantitative. The chemical yield, determined by colorimetry of the chromate, varies from 70 to 80%. (tr-auth)

5841 NONDESTRUCTIVE DETERMINATION OF POTASSIUM IN BIOLOGICAL SAMPLES, IN VITRO AND IN VIVO, BY ITS VERY LOW ENERGY CAPTURE GAMMA RADIATION. Kellershohn, C.; Comar, D.; Maziere, B. (Commissariat a l'Energie Atomique, Orsay, France). J. Radioanal. Chem.; 16: No. 2, 663-672(1973). (In French).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Samples of kidney, brain, liver, and muscle powders were exposed to a thermal neutron flux of 5×10^7 n/cm^2/sec from which all fast and epithermal neutrons and fission γ had been eliminated. The 29-kev ray of K was detected with a Si(Li) detector to determine if this ray could be used to measure the K content of the samples in vitro. This ray was easily detected from the background. A mouse was exposed to the same radiation to determine if the K could be detected in vivo. The results showed that the 29-kev radiation of K can be used to measure the K content in vitro and in vivo. (JSR)

5842 DETECTION OF FIREARM DISCHARGE RESIDUES BY X-RAY EXCITATION. Barnes, B. K.; Beghian, L. E.; Kegel, G. H. R.; Mathur, S. C.; Quinn, P. (Lowell Tech. Inst.). J. Radioanal. Chem.; 16: No. 2, 453-459(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The application of the charged particle x-ray excitation technique (CPXE) to the problem of determination of residues from gun firing is described. Preliminary results indicate that certain elements, including S, Ba, Fe, and Pb can be detected in statistically significant larger amounts on firing hands than on nonfiring

hands with 90 to 98% confidence limits. Results for other elements including K, Ca, Sb, Cr, Mn, Ni, Cu, are also discussed. The simplicity of the technique, together with the number of elements detected, offers advantages over other techniques for firearm discharge residue detection. (auth)

5843 SOME ANALYTICAL INVESTIGATIONS INTO THE USE OF X-RAYS EMITTED DURING CHARGED-PARTICLE IRRADIATION. Peisach, M.; Newton, D. A.; Peck, P. F.; Pierce, T. B. (Atomic Energy Research Establishment, Harwell, Eng.). J. Radioanal. Chem.; 16: No. 2, 445-452(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

X-radiation emitted as a result of charged particle irradiation offers a means of extending the scope of analytical methods based on the measurement of prompt radiation. X-ray yields from a number of pure materials have been examined over a range of particle energies and x-ray measurement applied to the determination of a number of constituents in aluminium alloys. An examination of the distribution of silicon and germanium across an electronic component has been carried out using a small-diameter incident ion beam. (auth)

5844 INVESTIGATION OF THE DEPTH DISTRIBUTION OF IMPURITIES BY CHARGED-PARTICLE ACTIVATION. Krasnov, N. N.; Konstantinov, I. O.; Malukhin, V. V. (Atomic Energy Commission, Moscow). J. Radioanal. Chem.; 16: No. 2, 439-444 (1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A method is described for the quantitative determination of the distribution of impurities, utilizing charged particles. Experimental data obtained by activation with 7.5-Mev ^{3}He ions are reported on the distribution of oxygen in Ge and Nb samples. (auth)

5845 DETERMINATION OF Ti, V, Zn, and W TRACES BY PROTON ACTIVATION ANALYSIS. Krasnov, N. N.; Sevastyanov, Yu. G.; Konstantinov, I. O.; Vinogradova, V. G.; Malukin, V. V. (Atomic Energy Commission, Moscow). J. Radioanal. Chem.; 16: No. 2, 395-402(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Procedures are described for determining traces of titanium in scandium, vanadium in titanium, zinc in copper and tungsten in tantalum, utilizing activation with 11-MeV protons. Experimental data on ^{48}V, ^{51}Cr, ^{66}Ga and ^{182}Re yields and analytical sensitivities are reported. (auth)

5846 COMPLEMENTARY USE OF MICROANALYSIS BY THE DIRECT OBSERVATION OF NUCLEAR REACTIONS AND OF BACKSCATTERING INDUCED BY CHARGED PARTICLES. Abel, F. (Ecole Normale Superieure, Tour, France); Amsel, G.; D'Artemare, E.; Bruneaux, M.; Cohen, C.; Maurel, B.; Ortega, C.; Rigo, S.; Siejka, J.; Croset, M.; Dieumegard, D. J. Radioanal. Chem.; 16: No. 2, 567-586(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Techniques are described which combine the use of nuclear reactions and of backscattering to obtain analytical results that would be difficult or impossible to reach using one of these methods only. The principles of stoichiometry determination by plateau height analysis are developed both for backscattering and for narrow resonances of nuclear reactions. Examples of applications are given to the determination of the composition of various thin films of aluminium and silicon oxides, silicon nitrides and calcium fluorides. The analysis of samples smaller than the beam, using backscattered particle monitoring, is presented. (auth)

5847 NUCLEAR REACTION ANALYSIS OF PHOSPHORUS IN SILICON. Ligeon, E.; Bruel, M.; Bontemps, A.; Chambert, G.; Monnier, J. (CEN, Grenoble, France). J. Radioanal. Chem.; 16: No. 2, 537-550(1973). (In French).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The determination of phosphorus is presented using the ^{31}P(p, α) ^{28}Si reaction. The principle of the method and the instrumentation are discussed as well as the precision, sensitivity, and the influence of the target thickness. The method is especially suitable for the investigation of diffusion phenomena. The concentration profiles are shown in silicon samples for various times of pretreatment. The interpretation of the profiles is given. (auth)

5848 ACTIVE ^{3}He ACTIVATION ANALYSIS FOR CARBON AND OXYGEN. Sanders, W. M.; Barnes, B. K.; Holm, D. M. (Los Alamos Scientific Lab., Los Alamos NM). J. Radioanal. Chem.; 16: No. 2, 525-535(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The surface and body concentrations of carbon and oxygen were measured in various materials using prompt ^{3}He activation techniques. Thin target excitation functions were determined for (^{3}He, p) reactions with carbon and oxygen over a ^{3}He energy range from 2.5 to 9.0 MeV. These data were used in the calculations of activation curves for various combinations of incident particle energy, impurity distributions, and material. Information on a computer code that was used in the analysis of the data is presented. (auth)

5849 DETERMINATION OF FLUORINE ON THE SURFACE OF METALS BY DETECTION OF PROMPT GAMMA PHOTONS FROM THE 19F(p, γ)^{16}O. Golicheff, I.; Engelmann, C. (CEN, Orsay, France). J. Radioanal. Chem.; 16: No. 2, 503-524(1973). (In French).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The 837-keV resonance is used for rapid and nondestructive determination of the gradient of fluorine on the surface of metallic samples. The precise yield curve of this resonance for thick target and the experimental sensitivity of the method were determined. With this method less than $5 \cdot 10^{-4}$ $\mu g \cdot cm^{-2}$ fluorine content can be measured. The resolution is of the order of 1000Å in aluminium and the concentration profiles can be measured to the depth of 1 μm. The time requirement of a surface analysis is 15 to 30 min, and 2 to 3 h of a gradient measurement. In addition, this method is simpler and more sensitive than the detection of the 1350-keV alpha particles from the ^{19}F(p, α_0)^{16}O reaction. (auth)

5850 NONDESTRUCTIVE DETERMINATION OF DEPTH DISTRIBUTION PROFILE OF TRACES OF FLUORINE. Application to dental enamel. Porte, L.; Sandino, J. P.; Grea, J.; Thomas, J. P ; Tousset, J. (Univ. Claude Bernard de Lyon, Villeurbance, France). J. Radioanal. Chem.; 16: No. 2, 493-502 (1973). (In French).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A nondestructive method is proposed for the determination of fluorine in dental enamel. The detection of the prompt gamma rays emitted by bombarding with 3-MeV protons lead to the solution of an equation system giving the average fluorine content in the successive layers of the sample. The mathematical treatment of this system is discussed as well as its improvement and generalization. (auth)

5851 DEPTH DISTRIBUTION OF LIGHT ELEMENTS IN HEAVY MATRICES WITH CHARGED-PARTICLE-INDUCED REACTIONS. Lorenzen, J.; Brune, D.; Malmskog, S. (Aktiebolaget Atomenergi, Studsvik, Sweden). J. Radioanal. Chem.; 16: No. 2, 483-492(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Two different methods are described for measuring the depth distribution of carbon, nitrogen, and oxygen in metals: Proton activation makes use of resonances in the excitation function of the (p, γ) reactions for depth determination, and with the aid of the different half-lives for β^+-decay provides information on the different constituents present. The other method makes use of the shape of neutron groups in the time-of-flight spectra from deuteron-induced reactions. Depths of some tens of microns with a resolution of fractions of a micron are studied. The detection limit is of the order of 100 ppM. (auth)

5852 ANALYTICAL USE OF NEUTRON-CAPTURE GAMMA-RAYS. Henkelmann, R.; Born, H. J. (Technishe, Univ., Munich). J. Radioanal. Chem.; 16: No. 2, 473-481(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Certain elements which are not possible to detect with conventional neutron activation analysis can be measured using thermal neutron-capture gamma analysis. The use of a curved neutron guide at the High Flux Reactor, Grenoble, with a thermal neutron flux of $1.5 \cdot 10^6$n $\cdot$ cm^{-2} $\cdot$ sec^{-1} and the advantage of a low-background counting system (Ge(Li) detector) far from the reactor core are described. Experimental detection limits of a number of elements are given for the low-energy and the high-energy regions. Some applications of the capture gamma method in the whole energy range are studied and are briefly discussed. (auth)

5853 RADIOGRAPHIC METHODS FOR ELEMENTAL ANALYSIS OF BORON, LITHIUM, RADIUM, URANIUM, AND THORIUM IN MINERALS AND ROCKS. Flerov, G. N.; Berzina, I. G. (Atomic Energy Commission, Moscow). J. Radioanal. Chem.; 16: No. 2, 461-472(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The feasibility is discussed of applying different radiation sources for f-radiography, (n, α)-radiography and autoradiography for the determination of the spatial distribution, and the local and total concentrations of boron, lithium, radium, uranium and thorium in various materials, achieving high sensitivity and accuracy. Results demonstrating the application of the developed methods of radiography in geological practice are presented. (auth)

5854 DETERMINATION OF FLUORINE IN PLANT MATERIALS. van der Mark, W. (Dutch National Reactor Center, Petten, Netherlands). J. Radioanal. Chem.; 16: No. 2, 637-641(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Determination of fluorine in plant materials by fast neutron and thermal neutron activation analysis is discussed. (LK)

5855 STUDY OF THERMALLY OXIDIZED SiO_2 SURFACE LAYERS BY MEANS OF NUCLEAR REACTIONS. Turos, A.; Wielunski, L.; Barcz, A.; Olenski, J. (Institute of Nuclear Research, Warsaw). J. Radioanal. Chem.; 16: No. 2, 627-636 (1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The structure of SiO_2 layers, grown thermally on silicon, was investigated using the nuclear reaction method. The following properties of oxide surface layers were determined: total number of oxygen nuclei, thickness, and oxygen concentration profile. (LK)

5856 DETERMINATION OF 30 ELEMENTS BY ACTIVATION WITH 11-MeV PROTONS. Barrandon, J. N.; Bebrun, J. L.; Kohn, A. (CEN de Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 16: No. 2, 617-626(1973). (In French).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Thirty elements were irradiated with 11-MeV protons. Present here are: (1) The specific activities for the main radioisotopes produced by (p, n) or (p, α) reactions (on main γ rays except the 511 keV). (2) The main γ energies of these radioisotopes (at ± 0.3 keV) when they have not been accurately measured previously. (3) The limits of detection or the lowest amounts measured in samples of Al, Ag or Co. From these preliminary results it can be deduced that 11-MeV protons offer new possibilities in the field of activation analysis. (auth)

5857 IMPROVED NEUTRON MONITOR GEOMETRY FOR NEUTRON ACTIVATION. Jarjis, R. A.; Hunt, S. E. (Univ. of Aston, Birmingham, Eng.). J. Radioanal. Chem.; 16: No. 2, 611-616(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The neutron monitor proposed is that the sample be in the form of a disc and that the flux monitoring material surround it in a concentric ring. The excitation function of aluminum was measured. (LK)

5858 MULTI-ELEMENT ANALYSIS OF ATMOSPHERIC PARTICULATE MATERIALS BY INSTRUMENTAL PHOTON ACTIVATION. Lutz, G. J.; Aras, N. K.; Zoller, W. H.; Gordon, G. (National Bureau of Standards, Washington, DC). J. Radioanal. Chem.; 16: No. 2, 609(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Samples were irradiated in the 45-degree facility of the NBS electron linac. The electron energy was 35 MeV and the beam current was approximately 50 μA. Irradiations were usually conducted for a few hours. After irradiation the samples were counted with a high volume Ge(Li) detector. The elements Na, Cl, Ca, Ti, Cr, Ni, Zn, As, Br, Zr, Sb, I, Ce, Pb, Fe, Se and Rb were observed. (LK)

5859 RAPID DETERMINATION OF ERBIUM USING GAMMA-RAYS FROM ^{24}Na RADIATION SOURCES. Veres, A. (Inst. of Isotopes, Budapest). J. Radioanal. Chem.; 16: No. 2, 605-607 (1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

An analytical method is described for the determination of erbium in rock samples using γ rays from a ^{24}Na radiation source. A detection limit of 1 μg erbium in 10-g samples can be achieved using a 200-Ci ^{24}Na source. The time required for a single analysis is about 5 minutes. (auth)

5860 RATIO MATCHING: A STATISTICAL AID FOR DISCOVERING GENERIC RELATIONSHIPS AMONG SAMPLES. Anders, O. U. (Dow Chemical Co., Midland, MI). J. Radioanal. Chem.; 16: No. 2, 643-653(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A technique of matching the ratios of elemental concentrations of a sample with the equivalent ratios of other samples is described. The resulting correlations are indications of potential generic relationships among the samples. Experimental data based on 91 sediments analyzed for As, Sb, Cu, Zn, Au, Cd, Hg, and Cr by neutron activation analysis is used to demonstrate the ability of the method. Three typical examples show the relatively high correlations achieved between samples for which close generic relationships could be explained, post facto, by geographical evidence. (auth)

5861 PROCESSING OF NEUTRON ACTIVATION ANALYSIS DATA USING A GENERAL PURPOSE PDP-11 MINICOMPUTER. Roth, J. R.; Morrison, G. H. (Cornell Univ., Ithaca, NY). J. Radioanal. Chem.; 16: No. 2, 655-661(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A minicomputer system is described for the off-line reduction of gamma spectral data from neutron activation analysis. The hardware and software systems are described. Both data printouts and spectral plots are produced. The versatility of system permits the availability of computer capability for both on- and off-line functions in a variety of analytical techniques at a moderate cost and under the control of the experimenter. (auth)

5862 DETERMINATION OF MICROGRAM QUANTITIES OF THORIUM IN URANIUM DIOXIDE BY NEUTRON ACTIVATION ANALYSIS. Ravnik, V.; Levstek, M.; Dermelj, M.; Kosta, L. (Ljubljana Univ., Yugoslavia). Vestn. Slov. Kem. Drus.; 19: No. 1-4, 5-12(1972).

A method is described for the routine determination of thorium in reactor-grade uranium dioxide. The sample is dissolved in hydrochloric acid and hydrogen peroxide and evaporated to dryness. The residue is dissolved in 8N hydrochloric acid and passed through an anion exchange column of Dowex 1 × 8 to remove uranium. The eluate is irradiated for 20 to 40 hours in a reactor at a thermal neutron flux of 2×10^{12} neutrons/cm^2 sec. After irradiation, ^{233}Pa is extracted with TBP in CCl_4 and the organic layer is counted for ^{233}Pa by γ-spectrometry in a NaI(Tl) detector using the 0.31 MeV peak. A discussion of the results and their accuracy is included. (auth)

5863 DETERMINATION OF SOME ATMOSPHERIC POLLUTANTS BY NEUTRON ACTIVATION ANALYSIS. Miyamaru, M. Sao Paulo, Brazil; Univ. Sao Paulo (1972). 56p. (In Portuguese).

Thesis.

Thermal neutron activation is used to analyze the elements mercury, bromine, arsenic, antimony and selenium, quantitatively, present in the atmosphere at the campus of the University of São Paulo. The elements are collected in "Millipore" filters by suctioning about 40 cm^3 of air through the filter. Chemical separation is achieved by distillation of bromine and bromides of the other four elements, which are, lately, retained individually in anion exchanger resins. Arsenic and selenium are collected in the same resin column. Zinc, sodium, scandium, iron, copper, samarium, lanthanum, potassium, tungsten, and chromium were qualitatively identified in the residue of the distillation. A GE(LI) counter was used for the qualitative analysis of the elements in the residue and NaI(Tl) for the quantitative determination of arsenic, bromine, antimony, selenium, and mercury. All concentrations found are below maximum permissible levels for those five elements. (INIS)

5864 DETERMINATION OF RARE EARTHS IN GEOLOGICAL SAMPLES AND RAW MATERIALS. Haskin, L. A.; Korotev, R. L. (Univ., Wisconsin, Madison). pp 183-211 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

The relative abundances of the rare-earth elements (REE) in rocks and minerals are related to those of the chondritic meteorites, which are believed to have preserved the REE with the same relative abundances as were present in the primitive matter from which the planetary bodies in the solar system developed. The relationships among relative REE abundances in different materials are most easily seen through the use of comparison diagrams with chondritic meteorites or with more immediately related materials. On such diagrams, differences in relative REE abundances between two materials appear, except for Ce and Eu, as smooth functions of REE atomic number. This is a consequence of the type of chemical separations that accompany rock-forming processes. Accurate and sensitive geochemical analysis is now done mostly by neutron activation analysis or mass spectrometric isotope dilution, sometimes on nanogram and subnanogram quantities of the individual REE. Precision

for isotope dilution is a fraction of a percent, that for neutron activation ranges from about ±1% to about ±10%, depending on the element. Useful data are also obtained by spark-source mass spectrometry and X-ray fluorescence, with precision ranging upwards from about ±10%. Because all rocks and minerals apparently give smooth curves on comparison diagrams with chondritic meteorites, very accurate concentrations for unanalyzed REE can be obtained by interpolation on comparison diagrams drawn through ratios for carefully analyzed REE. Reasonably good estimates for most of the REE can be obtained from estimated comparison diagrams based on analyses for as few as 4 of the REE. (auth)

5865 DETERMINATION OF ATMOSPHERIC CONCENTRATIONS OF STABLE IODINE. McFarland, R. C.; Walker, D. M.; McLain, M. E. Jr. (Georgia Inst. of Tech., Atlanta). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 503-509(Feb 1974).

From twentieth nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The importance of specific activity methods in the evaluation of radiological hazards due to the atmospheric release of ^{129}I and ^{131}I has prompted the development of analytical methods for determining atmospheric stable iodine concentrations. An analytical procedure based on neutron activation analysis for iodine trapped on filter paper and activated charcoal was developed. This procedure was used to measure the airborne stable iodine concentrations in several areas around Atlanta, Georgia, and Barnwell, South Carolina. Airborne stable iodine concentrations determined in this study are in the range 10^{-9}–10^{-8} g/m^3. These concentrations are consistent with others reported in the United States but fall below those reported in the United Kingdom by a factor of 100. The collection and retention of iodine on charcoal appears to depend on the following factors: air flow rate, chemical form, presence of oxides of nitrogen, and relative humidity. The influence of these factors on iodine collection and retention on charcoal is in need of further study as related to airborne iodine measurements. (auth)

5866 DETERMINATION OF SILVER IN ANCIENT AND RARE COINS BY NEUTRON ACTIVATION ANALYSIS WITH 252-CALIFORNIUM. Katz, S. A. (Rutgers—The State Univ., Camden, NJ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 633-634(Feb 1974).

From twentieth nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A low-flux, ^{252}Cf neutron source has been employed for the radioactivation of silver in ancient and rare coins. By careful control of the activation time and cooling period, a high degree of selectivity for silver was achieved. Data were normalized to compensate for self-shielding by employing empirical correction factors. Nondestructive measurements of the silver contents of coins having historical or numismatic value were possible. (auth)

5867 DETECTION SYSTEMS FOR THE LOW LEVEL RADIOCHEMICAL ANALYSIS OF IODINE-131, IODINE-129, AND NATURAL IODINE IN ENVIRONMENTAL SAMPLES. Brauer, F. P.; Kaye, J. H. (Battelle Pacific Northwest Labs., Richland, WA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 496-502(Feb 1974).

From twentieth nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A procedure based on chemical separation techniques and activation analysis has been developed for the sequential analysis of low levels of ^{131}I, ^{129}I, and natural iodine in environmental samples. The iodine is first separated from the samples by oxidation. The separated iodine is then counted by low level, beta-gated gamma-ray spectrometry for the measurement of ^{131}I. The chemical yield for the separation is measured by means of ^{125}I tracer. Activation analysis is used for measurement of the separated natural iodine (^{127}I) and ^{129}I. The natural iodine is estimated from either the ^{126}I or ^{128}I activity produced in the sample; the induced ^{130}I is used to estimate the ^{129}I concentration. The measurement of ^{130}I at low levels requires specialized counting methods. Interfering activities which may be present in the irradiated sample include ^{125}I, ^{126}I, short-lived fission-product iodine activities produced by activation of uranium impurities, and ^{82}Br from bromine impurities. Since ^{130}I decays with several coincident gamma rays, multiple gamma- coincidence counting techniques can be used to reduce background and discriminate against interfering activities. Several three-and four-segmented NaI(Tl) detectors have been used for these measurements and compared with other detector systems. The sensitivities for different coincidence counting modes were compared for several of the detector systems. Detection sensitivities achieved for ^{131}I and ^{129}I are 0.02 dpm and 10^{-3} dpm, respectively. Measurements have been made of iodine radioactivity in the environment at concentrations below the limits established for radiation protection purposes. (auth)

5868 NEUTRON ACTIVATION ANALYSIS OF SOME OF THE BIOLOGICALLY ACTIVE TRACE ELEMENTS IN FISH. Pillay, K. K. S.; Thomas, C. C. Jr.; Hyche, C. M. (State Univ. of New York, Buffalo). pp 415-420 of Trace Substances in Environmental Health. Hemphill, D.D. (ed.). Columbia, MO; Univ. of Missouri (1973).

From seventh annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973). See CONF-730613-.

Highly specific neutron activation analysis procedures involving post-irradiation chemical separations were developed for the determination of Cu, Hg, Zn, Cd, As, Se and Cr in fish tissues. The procedures developed were used to determine the levels of these biologically active elements in some of the commercially important fish species of Lake Erie. The nuclear analytical procedures developed generally involved the irradiation of fish tissues followed by wet-ashing in the presence of nonradioactive carriers. From the homogeneous solution of the tissue digest, the elements of interest were chemically isolated and the radioactivities were measured by scintillation gamma ray spectrometry. The results reported include both the determination of the precision and accuracies of each of these elemental analyses and a survey of these seven elements in nine major fish species of Lake Erie. (auth)

5869 UTILIZATION OF SPARK MASS SPECTROMETRY AND RADIOACTIVATION TO DETERMINE THE CHARACTERISTICS OF SEMICONDUCTORS. Cornu, A. (CEN, Grenoble, France). pp 435-446 of Proceedings of the Colloquium on the Characterization of Semiconductor Materials and Technologies. Lafeuille, D. (ed). Grenoble, France; Centre d'Etudes Nucleaires (1972). (In French).

From proceedings of the colloquium on the characterization of semiconductor materials and technologies; Grenoble, France (27 Sep 1972).

Two methods suitable for the determination of traces in small samples are presented: spark mass spectrometry and activation analysis (thermal neutron activation, activation using 14-MeV neutrons, γ rays, and charged particles). The two methods are complementary. The properties of the material under investigation are determined using spark mass spectrometry, which enables the impurities present to be analyzed. It is then possible to select the most suitable method of determination for the impurities of interest, activation methods often being used. (FR)

5870 DETERMINATION OF YTTRIUM IN ROCKS BY NEUTRON ACTIVATION AND A SIMPLE GROUP SEPARATION. Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). Talanta; 21: No. 2, 178-182(Feb 1974).

A neutron-activation method is proposed for the determination of yttrium in rocks by separation of the rare-earth group and β-counting. Interferences from rare-earth nuclides and the necessary corrections are discussed, and results for some standard rocks are presented. The method is suitable for combination with rare-earth determinations by group separation and Ge(Li) γ-spectrometry. (auth)

5871 MERCURY IN MUSHROOMS. Schelenz, R.; Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 154: No. 3, 160-161(Mar 1974). (In German).

The mercury content of canned and fresh mushrooms was determined by neutron activation analysis. The average mercury concentration was found to be 129 μg/kg, with extreme values of 6-447 μg/kg. It appears that the mercury content increases with the size of the mushrooms and that it is decreased by canning. (GE)

5872 NONDESTRUCTIVE DETERMINATION OF THE NOBLE METALS BY THERMAL AND EPITHERMAL NEUTRON ACTIVATION ANALYSIS USING HIGH RESOLUTION GAMMA SPECTROMETRY. Turkstra, J.; Smit, H. J.; de Wet, W. J. J. S. Afr. Chem. Inst.; 25: No. 3, 254-267(Feb 1972).

The potential and limitations of instrumental reactor activation analysis using a Ge(Li) detector for the analysis of noble metals in various materials are discussed for both thermal and epithermal neutron activation procedures. Special attention is given to interferences in the simultaneous, nondestructive determination of the platinum metals in platinum-bearing ore matte and lead assay bead samples. The analysis of the individual platinum-group metals preconcentrated in lead beads proved to be feasible without any chemical treatment. However, in the determination of the platinum-group metals in platinum-bearing ores it was found that only gold, iridium, and platinum could be determined satisfactorily.

In matte samples only palladium posed problems in direct analysis. (INIS)

5873 ANALYTICAL METHODS FOR DETERMINATION OF RARE EARTHS. Brusydeylins, A. (Goldschmidt (Th.) A.G., Essen). Chem. Ztg.; 97: No. 10, 543-547(Oct 1973). (In German).

In this review, analytical methods for determination of rare earths are discussed. Mass spectroscopy, activation analysis, and x-ray and cathode-ray generated luminescence spectra are suitable for the determination of trace amounts of rare earths. X-ray-fluorescence, combined with chemical procedures, covers a wide range of applications. Conventional, wet-chemical methods allow the determination of the rare earths as a whole. (GE)

5874 DETERMINATION OF TRACE IMPURITIES IN PLATINUM BY NEUTRON-ACTIVATION ANALYSIS. Moiseev, V. E.; Timoeev, A. I. Tr. Inst. Fiz. Metal. Ural. Nauch. Tsent., Akad. Nauk SSSR; No. 28, 87-90(1971). (In Russian).

To determine traces of Sb, Bi, Ag and P in high-purity platinum or a platinum–rhodium alloy, the sample (≈30 mg) and standards are irradiated for 10 hr in a thermal-neutron flux of $\approx 3 \times 10^{13}$ neutrons per sq cm per sec, then set aside for 2 to 5 days. The sample is then treated with HCl and dissolved in aqua regia in the presence of carriers (10 to 20 mg) of the elements to be determined, and ammonium chloroplatinate and then AgCl are precipitated and filtered off. The sulfides of Sb and Bi are precipitated from the filtrate and the Be_2S_3 is dissolved in diluted HNO_3. Phosphorus is precipitated from the residual sample solution as NH_4MgPO_4. For purification, the Sb is extracted into benzene as the 8-hydroxyquinoline complex from H_2SO_4 solution and precipitated as the sulfide. The Bi is separated as the phosphate, then extracted into $CHCl_3$ from HNO_3 solution as the cupferron complex, and finally reprecipitated as the phosphate. The P is precipitated as ammonium molybdophosphate, and impurities are coprecipitated from solution with Sb_2S_3 and La oxalate, after which NH_4MgPO_4 is reprecipitated. Silver is separated as $AgIO_3$, impurities are coprecipitated with $Fe(OH)_3$, AgCl is precipitated and $AgIO_3$ is reprecipitated. The final precipitate in each instance is transferred to an aluminium support and weighed to determine the chemical yield (25 to 80%). The activity of ^{32}P and ^{210}Bi is measured for 30 min with a β-counter, and that of ^{122}Sb and ^{110m}Ag is measured at the 0.564- and 0.656-MeV photo-peaks, respectively, on a γ-spectrometer with a NaI(Tl) crystal. The limits of detection (ppM) are Sb 0.02, Bi 0.4, P 0.1 and Ag 0.06. (Anal. Abstr.)

5875 MODIFIED APPROACH FOR SUBMICROGRAM DETERMINATION OF SELENIUM IN UNITED STATES GEOLOGICAL SURVEY STANDARD ROCKS. Lavrakas, V.; Golembeski, T. J.; Pappas, G.; Gregory, J. E.; Wedlick, H. L. (Lowell Technological Inst., MA). Anal. Chem.; 46: No. 7, 952-954(Jun 1974).

Selenium in various rocks is determined by neutron activation analysis. An efficient and simple solvent extraction method is used to purify selenium prior to analysis for ^{75}Se by gamma spectroscopy. (auth)

5876 NONDESTRUCTIVE ANALYSIS FOR SILICON, RUBIDIUM, AND YTTRIUM IN ATMOSPHERIC PARTICULATE MATERIAL. Olmez, I.; Aras, N. K.; Gordon, G. E.; Zoller, W. H. (Univ. of Maryland, College Park). Anal. Chem.; 46: No. 7, 935-937(Jun 1974).

The advantages of instrumental photon activation analysis as a reliable, nondestructive method for measuring the concentrations of Si, Rb, and Y in atmospheric particulate material are discussed. (auth)

5877 MERCURY IN AN ESTAURINE MUSSEL POPULATION: QUANTITATIVE RESULTS OBTAINED BY ACTIVATION, SPECTROPHOTOMETRIC, AND ELECTROANALYTICAL TECHNIQUES. Kadish, K. M.; Van Willis, W.; Arnold, K. E. (California State Univ., Fullerton). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 602-604(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Use of neutron activation, atomic absorption, and anodic stripping voltametry for analyzing trace mercury concentrations in the mussel is discussed. Preparation of samples for measurement is considered. Comparative evaluations of the three methods of analysis are made. (LK)

5878 DETECTION OF THE STABLE ISOTOPES OF CARBON USING A 3-MV VAN DE GRAAFF AND THE APPLICATION OF ENVIRONMENTAL AND BIOLOGICAL STUDIES. Close, D. A.; Malanify, J. J.; Umbarger, C. J. (Los Alamos Scientific Lab., NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 731-734(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The proton radiative capture reactions, $^{12}C(p,\gamma)^{13}N$ and $^{13}C(p,\gamma)^{14}N$, have been studied to determine their applicability for assaying materials for their ^{13}C enrichment. This technique for determining carbon isotopic ratios compares favorably with the more classical analysis techniques for ^{13}C tracer experiments. (auth)

5879 DETERMINATION OF IODINE IN URINE BY NEUTRON ACTIVATION ANALYSIS. Application of the Szilard–Chalmers Effect. Blotcky, A. J.; Duven, D. M.; Grauer, W. W.; Rack, E. P. (Univ. of Nebraska, Lincoln). Anal. Chem.; 46: No. 7, 838-842(Jun 1974).

A procedure, making use of the Szilard–Chalmers effect, is outlined for the simple, rapid, quantitative determination of total iodine (≥0.05 μg/ml) in urine using ^{128}I neutron activation. The ^{128}I reactions, activated by radiative neutron capture (Szilard–Chalmers effect), in water, with dissolved solutes in water solution, and with urine are discussed. The procedure utilizing a low-power nuclear reactor ($\sim 1.1 \times 10^{11}$ n/cm^2 sec) consisted of irradiating urine samples, recovering the ^{128}I in urine by nitric acid-hydrogen peroxide oxidation and carbon tetrachloride solvent extraction, performing a radioassay for ^{128}I using a Ge(Li) detector, and determining the ^{128}I extraction yields in the oxidation–extraction procedure. The total iodine concentration in samples determined varied from <0.1 μg/ml to over 2000 μg/ml. The precision of the technique, which lends itself well to routine analysis, is <6%. Comparison between the results obtained by the discussed procedure and values obtained independently was good. (auth)

5880 METHODOLOGY PROBLEMS IN USING BETATRONS FOR RAPID GAMMA-ACTIVATION ANALYSIS OF MINERALS FOR SELENIUM. Vitazhents, G. Ch., Voropaev, V. I.; Martynov, Yu. T.; Sulin, V. V.; Suslov, V. G.; Shornikov, S. I. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 11-24 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

Methods are described for determining the Se content of ore samples and concentrates and possible uses of (γ, γ') and (γ, n) reactions for solving analytical problems by two gamma-activation techniques. It is considered that in the use of modern betatrons and other high-current bremsstrahlung sources the threshold of sensitivity for determining Se may be better than $10^{-4} - 10^{-5}$ wt%. (tr-auth)

5881 COMPARISON OF ION EMISSION AND NUCLEAR REACTION MICROANALYSIS METHODS. Blanchard, B.; Ligeon, E.; Monnier, J. (CEN, Grenoble, France). pp 347-352 of Proceedings of the Colloquium on the Characterization of Semiconductor Materials and Technologies. Lafeuille, D. (ed.). Grenoble, France; Centre d'Etudes Nucleaires (1972). (In French).

From proceedings of the colloquium on the characterization of semiconductor materials and technologies; Grenoble, France (27 Sep 1972).

Two microanalysis methods both having a good resolution and a high sensitivity are presented. The ion analyzer is suitable for measuring concentrations as a function of depth. Nevertheless, when analyzing impurities in an inhomogeneous medium, the emission rate varies with crystal composition. It is thus useful to utilize nuclear reaction analysis in conjunction with ion abrasion techniques. (FR)

5882 ACTIVATION METHOD FOR SIMPLIFIED SILICATE ANALYSIS OF ALKALINE ROCKS, USING A BETATRON. Brovtsyn, V. K.; Vitozhents, G. Ch.; Martynov, Yu. T.; Porokhov, S. N.; Sulin, V. V.; Shornikov, S. I. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 140-163 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The determination of Al, Na, and Mn in rock samples by neutron activation with photoneutrons from a betatron is described. Good results obtained with the method are presented. (tr-auth)

5883 POTENTIAL USE OF GAMMA-ACTIVATION ANALYSIS FOR A HIGH-SENSITIVITY AND ACCURATE DETERMINATION OF ANTIMONY IN POLYMETALLIC ORES AND MATRIX ROCKS. Vitozhents, G. Ch.; Sulin, V. V.; Khrynin, B. A. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 24-63 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

On the basis of known photoneutron properties of antimony isotopes and the gamma-activation characteristics of this ele-

ment, the possibility was established of using the gamma-activation properties of these isotopes for determining antimony in samples of polymetallic ores and matrix rock. Experimental data were used for selecting the best activation conditions. Simultaneous analysis for antimony and copper and for antimony, copper, molybdenum, and lead was shown to be possible, with threshold sensitivities of 2×10^{-4}, 1×10^{-4}, and 3×10^{-3} wt % when using a microtron or a linear electron accelerator. (tr-auth)

5884 SENSITIVITY OF GAMMA-ACTIVATION ANALYSIS. Davydov, M. G.; Mantopatin, V. A.; Nikitin, V. N.; Shcherbachenko, V. A. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 171-183 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

As the criterion of the sensitivity of γ-activation analysis is proposed a value that is a multiple of the absolute value of the standard deviation of the background count rate. The background due to the induced activity of elements in the matrix is given as the product of the flux of the activating radiation, the sample weight, and the γ-activation parameter. The relation is shown between the sensitivity with selective analysis and formulas are given for calculating the limit of detection of an element in a multi-component medium under any conditions of analysis. Possibilities are discussed for increasing the sensitivity of the analysis (increase in selectivity, activating radiation flux, and sample weight and decrease in recording equipment background), and transparent graph paper is suggested for rapid estimation of the sensitivity of gold determination by γ-activation. (tr-auth)

5885 COMPLEX GAMMA-ACTIVATION DETERMINATION OF Se AND S IN SULFIDES USING SHORT-LIVED ACTIVATION PRODUCTS. Martynov, Yu. T.; Syslov, V. G.; Shornikov, S. I. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 25-32 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

Geochemical features of Se and S, their paragenetic bond in mineral ores, and chemical and physicochemical methods of determining these elements in geological samples are discussed. It is shown that gamma-activation properties of Se and S isotopes are suitable for rapid activation analysis of sulfide ores, using the short-lived isotopes ^{31}Se ($T_{\frac{1}{2}}$ = 2.6 sec) and ^{77m}Se ($T_{\frac{1}{2}}$ = 17.5 sec). The results of activation of artificial mixtures of chemical compounds and sulfide polymetallic ores by betatron bremsstrahlung radiation with a maximum energy of 20 MeV and direct gamma measurement with a scintillation counter confirmed the possibility of simultaneous determination of Se and S in the samples studied. (tr-auth)

5886 USE OF THE HIGH-CURRENT B-25 LUCH BETATRON FOR HIGH-SENSITIVITY GAMMA-ACTIVATION ANALYSIS OF ROCKS AND ORES FOR Cu, Zr, AND Ti. Berzin, A. K.; Vitozhents, G. Ch.; Meshcheryakov, R. P.; Sulin, V. V.; Shornikov, S. I.; Yakovlev, B. M. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 33-43 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The high-current B-25 betatron, Luch, was used for high-sensitivity gamma-activation analysis of rock and ore samples of Samotkanskii alluvial deposits for Ti and Zr and geochemical samples of Belo-usovskii polymetallic deposits for Cu. Results are given of tests and development of analytical methods indicating completely satisfactory agreement of data from gamma-activation and chemical (or spectroscopic) determinations of Ti, Zr, and Cu in the samples studied. (tr-auth)

5887 GAMMA-ACTIVATION ANALYSIS OF Ti-Zr ORES AND CONCENTRATES FOR Hf. Martynov, Yu. T.; Sulin, V. V.; Shornikov, S. I. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 83-98 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofizki i Geokhimii (1972). (In Russian).

A method was developed for γ-activation analysis of Ti-Zr ores and processing products for Hf, using the ^{179m}Hf isomer. The ^{179m}Hf is formed in the simultaneous (γ,n) and (γ,γ') reactions on stable ^{180}Hf and ^{179}Hf, using a betatron 25-MeV bremsstrahlung. Scintillation spectra of the induced γ-activity of Hf nitrate and of a number of Ti-Zr ores indicate that Hf can be determined with the 0.217-MeV photopeak. Results obtained with more than 100 samples of Ti-Zr ores, matrix rocks, industrial products, concentrates, and minerals containing 0.0006-4.61% Hf are given. The data were compared with data from physicochemical, spectral, and neutron-activation methods. Absolute (δ) and relative (f) square root deviations of the γ-activation and control results for the samples studied and three classes of Hf compounds showed for compounds <0.0049%, σ = 0.006%, f = 27.7 rel. %; for 0.05-0.499%, σ = 0.015%, f = 10.0 rel. %; for >0.5%, σ = 0.063, f = 4.4 rel. %. The precision of the method is 1.2 to 2.7 rel. % for samples with Hf contents from 4.5 to 0.05 wt %. The method can be used on 100- to 150-g samples of sand and other loose substances with grain size 1 to 2 mm without preliminary processing. Hafnium and Zr can be determined simultaneously, and the method can be combined with already developed γ-activation methods for determining Ti in ores and rocks. (tr-auth)

5888 POTENTIAL PRACTICAL APPLICATION OF GAMMA ACTIVATION IN DETERMINING THE MOLYBDENUM CONTENT OF ROCKS AND ORES. Burmistenko, Yu. N.; Vitozhents, G. Ch.; Sulin, V. V.; Feoktistov, Yu. V.; Khrynin, B. A. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 64-82 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

Geochemical properties of Mo, methods for determining it in rocks and ores, and the gamma-activation properties of all 7 Mo isotopes are discussed. For high sensitivity the ^{99}Mo isotope was selected, and two methods are described with a sensitivity of 2×10^{-3} wt %. Good results are shown of determinations of Mo in Be-W-Mo, Cu-Mo, and polymetal ores. In the samples studied, Cu, W, Mo, Co, and Mn were determined simultaneously. (tr-auth)

5889 SELECTION OF OPTIMUM PARAMETERS IN INSTRUMENTAL ACTIVATION ANALYSIS. Gruzdev, Yu. V. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 164-170 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofizki i Geokhimii (1972). (In Russian).

A grid method was used to analyze the general expression of the statistical error of measurement of the induced activity of an element being determined in the presence of background activity and the activity of an interfering element. Graphs are shown that can be used for determining the optimum irradiation, cooling, and induced-activity measurement times with the least statistical error of measurement. (tr-auth)

5890 PHOTOACTIVATION DETERMINATION OF Ge IN SAMPLES OF COMPLEX CHEMICAL COMPOSITION. Berzin, A. K.; Gruzdev, Yu. V. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 99-104 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

A method was developed for determining Ge in rock and ore samples of complex chemical composition. The equipment consists of two counters with NaI (Tl) crystals, 75 by 75 mm each, and two auxiliary counters with scintillators, 150 by 40 mm each. The ^{73m}Ge isotope (0.53 sec half-life) was selected for the measurements. The method was tested on artificial mixtures of chemical compounds of Ge, Er, Br, Au, Ir, W, and U and on rocks and was used for determining Ge in samples of sub-Moscow peats and in ultrabasic and basic rocks from the Urals, the Kol'skii Peninsula, the Ukraine, Priazovskoe, the Caucasus, and Western Sayan. The sensitivity of the analysis for Ge was 1×10^{-4} wt %. Activation data differed from chemical data no more than 20 rel. %. It was found that the Ge content of peat strata gradually increased with depth, reaching a maximum in the peat in contact with the earth. The average Ge content in ultrabasic and basic rocks was close to the known values. (tr-auth)

5891 POSSIBILITY OF PHOTONEUTRON ANALYSIS OF ROCK SAMPLES FOR ELEMENTS, USING ELECTRON ACCELERATORS. Berzin, A. K.; Khrynin, B. A. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 127-139 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofizki i Geokhimii (1972). (In Russian).

The results of theoretical calculations and experimental work indicated the possibility of determining Be, Li, Hg, and other elements in geological samples, using electron accelerators as the

γ-radiation source. The experiments were made on artificial mixtures of Be, Li, or Hg with chemical compounds of Si, Al, Fe, W, O, and C and with actual rocks. The low sensitivity for Hg and other elements whose (γ, n) reaction is greater than 6 MeV makes the photoneutron method not feasible for their determination. (tr-auth)

5892 ECONOMIC REQUIREMENTS FOR ACTIVATION ANALYSIS OF SILICATE PORTIONS OF ROCKS AND ORES. Mudrenko, V. M.; Sulin, V. V.; Tikhomirova, E. S.; Chepizhnaya, E. A. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 184-201 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

Calculations of the economics that may be expected from replacing current chemical methods for analyzing silicate ores and rocks with the new γ and photoneutron activation methods are reported. The results indicate that the introduction of these methods into a central geochemical laboratory for determining Al, Fe, K, Ca, Si, Mg, Mn, S, Ti, P, F, and other elements in rocks and ores would be profitable. (tr-auth)

5893 TRACE ELEMENT BEHAVIOR IN SOIL OF SOME INDONESIAN SAWAH'S AND IN SLUDGE OF AN INDONESIAN RIVER. Houtman, J. P. W. (Interuniversity Reactor Inst., Delft, Netherlands). Delft Progr. Rep., Ser. A; No. 1, 5-16 (Sep 1973).

Soil and sludge samples were taken during the beginning of the rainy season from three sawah's at various height levels near Tjiparaj and from the Tji Tarum river near the inflow of six side rivers along a 200 km stretch. These samples were purified from particles bigger than 16 μm by a sedimentation procedure. They were analyzed by nondestructive neutron activation analysis (NAA) for 22 elements (Na, K, Cs, Cu, Au, Hg, Cr, Mn, Fe, Co, As, Sb, Br, Sc, La, Ce, Eu, Yb, Tb, Hf, Ta, Th) and by destructive NAA for Zn, Cu and Hg. Indications have been obtained regarding absolute concentrations in sawah soils and about mobilization and adsorption phenomena in a tropical river. Moreover, certain elements (i.e. mercury) in river sludge show strong variations at specific points along the river. This might indicate the presence of geologically interesting concentrations of these elements in specific geographical areas. This should be further investigated. Finally some soil and fish samples from the near-shore part of the Java Sea were analyzed to measure the possible consequences of mercury discharge for the environment. (auth)

5894 PHOTON ACTIVATION ANALYSIS. Zoller, W. H. (Univ. of Maryland, College Park). pp 185-189 of Second Joint Conference on Sensing of Environmental Pollutants. Pittsburgh; Instrument Society of America (1973).

From American Chemical Society second joint conference on sensing of environmental pollutants; Washington, District of Columbia, USA (10 Dec 1973). See CONF-731205-.

Instrumental photon activation analysis (IPAA) using bremsstrahlung from an electron linac has been used to measure the concentrations of 19 elements in atmospheric particulate samples. The technique is sensitive, nondestructive and capable of analysis of fuels such as gasoline, fuel oil, residual oil and coal in addition to filter and cascade-impactor samples. The list of elements that are easily measurable down to the sub microgram range includes such important elements as Pb, Ni, As, Zn, Sb, Br and I. The sensitivity of IPAA is intermediate between neutron activation and atomic absorption. (auth)

5895 USE OF $\beta-\gamma$ COINCIDENCE MEASUREMENT TO IMPROVE THE SENSITIVITY OF NEUTRON ACTIVATION ANALYSIS OF EXTRAPURE SEMICONDUCTOR MATERIAL. Niese, S. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 10: No. 1, 25-28 (Jan 1974). (In German).

The use of $\beta-\gamma$ coincidence measurements in neutron activation analyses is described. The criteria used for selection of the measurement method are described, and the measurement installation is discussed. Its efficiency is evaluated. The reduction of the background by chemical separation of the nuclides to be measured is discussed and the chemical separation processes used are reported. The zero effect and the detection magnitudes are evaluated. The lowest measured heavy metal concentrations of Mn, Fe, Cu, Ag, and Au in Si and the theoretically calculated detection limits for these elements are tabulated and compared. (JSR)

5896 NEUTRON ACTIVATION ANALYSIS OF TIN BY EXTRACTION OF ^{113m}In. Allan, A.; Sanad, W. (Atomic Energy Establishment, Cairo). Radiochem. Radioanal. Lett.; 17: No. 3, 155-162 (6 May 1974).

A procedure is described for the neutron activation analysis of traces of tin in geological samples, through selective extraction of the induced daughter isotope ^{113m}In, using a long-chain tertiary amine. The procedure was tested by the analysis of tin in standard rocks G-1, and BCR-1. Agreement with literature values is satisfactory. (auth)

5897 DETERMINATION OF SELENIUM IN THE PRESENCE OF TELLURIUM BY NEUTRON ACTIVATION ANALYSIS FOLLOWED BY HIGH RESOLUTION GAMMA AND X-RAY SPECTROMETRY. Lavi, N. (Soreq Nuclear Research Center, Yavne, Israel). Radiochem. Radioanal. Lett.; 17: No. 3, 177-187 (6 May 1974).

Neutron activation followed by high-resolution gamma and x-ray spectrometry was applied for the determination of selenium in the presence of tellurium in different ratios. The gamma and x-rays, derived from activated samples of selenium and tellurium, were measured with calibrated Ge(Li) and Si(Li) detectors, respectively. The feasibility of determining both ^{75}Se(120 d) and ^{73m}Se(17.5 sec) in the presence of tellurium isotopes, ^{131}Te(25 min) and ^{131}I(8.05 d, daughter nuclide of ^{131}Te and ^{131m}Te), was investigated experimentally. The accuracy of the method is generally better than ±5% over the weight range 0.2-10 μg of selenium, and about ±20% for the range 0.01-0.2 μg. (auth)

5898 SOME RECENT DEVELOPMENTS IN SUBSTOICHIOMETRY FOR NEUTRON ACTIVATION ANALYSES. Nadkarni, R. A. (Cornell Univ., Ithaca, NY). Radiochem. Radioanal. Lett.; 17: No. 3, 207-209 (6 May 1974).

A review of the title topic by the author was published in J. Radioanal. Chem. 20 (1974). Articles appearing since submission of that paper are reviewed. (LK)

5899 NEUTRON ACTIVATION ANALYSIS OF SEMICONDUCTOR SILICON. Bereznai, T.; De Corte, F.; Hoste, J. (Ghent State Univ.). Radiochem. Radioanal. Lett.; 17: No. 3, 219-228 (6 May 1974).

Neutron activation analysis is described of epitaxial and some other critical layers of semiconducting silicon applying a multi-comparator method. (auth)

Chemical and Spectral Procedures

Refer also to abstract 6809.

5900 (ARH-912) MEASUREMENT OF NITRATE BY A SPECIFIC ION ELECTRODE. Puryear, D. A. (Atlantic Richfield Hanford Co., Richland, Wash. (USA). Separations Chemistry Lab.). 8 Nov 1968. Contract AT(45-1)-2130. 15p. Dep. NTIS $4.00.

The specific ion electrode can be calibrated with standard solutions of $NaNO_3$ in a concentration range from 10^{-1} to 10^{-5}M. Carbonate and ammonia ions do not interfere in concentrations of less than 0.1 M, but nitrite cannot be present in amounts greater than the nitrate without producing a positive bias. Specific ion electrode results obtained on ground water samples compare favorably with results using the phenoldisulfonic acid method. However, time required for analyses is 5 to 10 times less using the electrode measurement. (auth)

5901 (BARC-687) SPECTROGRAPHIC ANALYSIS OF PLUTONIUM BY CARRIER DISTILLATION TECHNIQUE. Dhumwad, R. K.; Joshi, M. V.; Kulkarni, V. T.; Patwardhan, A. B. (Bhabha Atomic Research Centre, Bombay (India). Fuel Reprocessing Div.). 1973. 33p. Dep. NTIS (US Sales Only) $4.75.

Details of the spectrographic analysis of plutonium by the carrier distillation technique are presented. Silver chloride is used as a carrier. Plutonium samples are mixed with uranium (1:3) and from the intensities of the selected spectral lines, concentrations of the impurities are read from the working curves of uranium standards. Twenty impurities can be estimated giving two different exposures with an average standard deviation of 17% at 67% confidence level. The effects on the excitation or volatilization of some impurities in the uranium oxide matrix (when mixed with plutonium oxide in different proportions) have also been studied. (auth)

5902 (BARC/I-72) CARRIER-DISTILLATION METHOD FOR THE DETERMINATION OF TRACE IMPURITIES IN TUNGSTEN OXIDE. Vengsarkar, B. R.; Ghodgaonkar, G. S.; Tahiliani, V. S. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 13p. INIS.

A spectrographic method is described for the determination of Al, As, Cr, Fe, Mg, Mn, Ni, Si and Sn in tungstic oxide. The tungstic oxide (WO_3) powder is mixed with an equal amount of graphite containing 10% of AgCl and 0.1% of Ga_2O_3. Silver chloride and gallium are used as the carrier and internal standard respectively. A charge of 50 mg is excited in a dc arc at 10 amps for a period of 40 seconds. Hilger large quartz spectrograph is employed in the region 2340-3180 Å. Different concentration ranges between 1 to

200 ppM are covered for the impurities, with standard deviation varying from 9 to 20%. (auth)

5903 (BARC/I-75) ESTIMATION OF PLUTONIUM IN DISSOLVER SOLUTIONS: A LITERATURE SURVEY. Nair, G. M.; Singh, N. P. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 14p. INIS.

A detailed literature survey of estimation of plutonium in dissolver solutions is reported. Different methods described in the literature such as radiometric, x-ray fluorescence, mass spectrometric, alpha spectrometric and some chemical methods such as coulometry, amperometry are also discussed. Tabulated results of dissolver solution analysis, electrolysis of potentials used at ORNL, primary coulometric titration of plutonium in 1M $HClO_4$ in presence of some common reagents are also given. (INIS)

5904 (BARC/I-106) GRAPHITE-SPARK METHOD FOR THE ESTIMATION OF TRACE RARE EARTHS IN SOLUTIONS. Grampurohit, S. V.; Bellary, V. P. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 5p. INIS.

A spark method is described for the determination of trace rare earths extracted from uranium or thorium. A known amount of the solution containing the rare earths is evaporated on top of flat graphite electrodes. A JACO-varisource is used to excite the spectra which are recorded using a Jarrell-Ash 3.4 meter grating spectrograph having 1200 grooves/mm. The absolute sensitivities attained by this method range from 0.05 to 0.5 μg. (auth)

5905 (BARC/I-110) SPECTROGRAPHIC ANALYSIS OF UO_2 FOR TRACES OF Ag AND Mo: A CARRIER-DISTILLATION METHOD. Vengsarkar, B. R.; Ghodgaonkar, G. S.; Khanna, P. P. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 6p. INIS.

An emission spectrographic method, using the carrier-distillation technique, is described for the analysis of UO_2 for trace amounts of Ag and Mo. The UO_2 sample is first converted into U_3O_8 by ignition and mixed with 5 wt % of Ga_2O_3 containing Cr as internal standard. 100 mg of the mixture is taken in a carrier-distillation electrode and excited in a dc arc at 10 amp for a period of 35 seconds. The Hilger large quartz spectrograph is employed in the region 2600 to 4000 Å for recording the spectra. The concentration ranges covered for the impurity elements are: Ag 1 to 10 ppM and Mo 5 to 100 ppM with a mean standard deviation of ±16%. (auth)

5906 (BARC/I-135, pp 101-106) POTENTIOMETRIC ESTIMATION OF PLUTONIUM UNDER SIMULATED CONDITIONS OF DISSOLVER SOLUTIONS. Nair, G. M.; Singh, N. P.; Keshav Chander; Joshi, J. K.; Godbole, A. G.; Kavimandan, V. D.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay). 1971.

A potentiometric method for estimation of plutonium under simulated conditions of dissolver solution is developed. A preliminary separation of plutonium from uranium and fission products is carried out on an anion-exchange column using Dowex 1 × 4(50-100 mesh), in nitrate form, as an anion exchanger. Out of the various loading conditions studied, conditioning of plutonium solution with U(IV) reduction followed by $NaNO_2$ treatment and then loading on the column gives the best results. Of the various eluting reagents tried, 0.35M HNO_3 at 60°C is found to be the best. Eluted plutonium is oxidized with AgO and excess AgO is destroyed with sulfamic acid. After 5 minutes a known quantity of Fe(II) in the form of ferrous ammonium sulfate is added. The excess Fe(II) is titrated with ceric sulfate using platinum indicator electrode and calomel reference electrode. (INIS)

5907 (BARC/I-135, pp 130-133) DETERMINATION OF PLUTONIUM BY MASS SPECTROMETRIC ISOTOPE DILUTION. Mathews, C. K.; Chitamber, S. A.; Kavimandan, V. D.; Shah, P. M. (Bhabha Atomic Research Centre, Bombay). 1971.

A method for plutonium estimation in the dissolver solution of a reprocessing plant is described. Stable isotope dilution with ^{242}Pu incorporated as a tracer is followed by mass spectrometric analysis. The relative standard deviation of a single mass spectrum is about 0.2% showing that the precision of measurement is very high. (INIS)

5908 (BARC/I-135, pp 136-142) DETERMINATION OF RARE EARTHS IN PLUTONIUM. Joshi, B. D.; Patel, B. M.; Page, A. G. (Bhabha Atomic Research Centre, Bombay). 1971.

A spectrochemical method using a combined carrier LiF-AgCl for the determination of rare-earths in plutonium at fractions of parts per million level has been developed. The rare-earths are separated from plutonium using anion exchange Dowex 1 × 4 (50-100 mesh) column. Plutonium is retained in the column and rare-earth impurities collect into the effluent. The effluent is evaporated and then dissolved in HCl solution for spectrographic analysis. The precision of estimation varies from 6 to 12% for different elements. The estimation of rare-earths is found to be not affected by the presence of plutonium and 13 non-rare earth elements in microgram quantities which accompany rare earths as impurities in the chemical separation. The method is suitable for the estimation of all rare earths (except Tm in plutonium at ppM concentrations) using only 100 mg Pu. With larger sample size it is possible to analyze rare earths at much lower concentration. (INIS)

5909 (BARC/I-226) SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM WITH OXINE. Joshi, M. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 4p. INIS.

A method is described for the simultaneous extraction and determination of vanadium as oxinate in diuranate samples and ores like ilmenite and rutile at 20 ppM and above. The absorbance of the complex extracted into isobutyl alcohol from aqueous solutions at pH 3.5–4.5 containing sodium fluoride is measured at 490 nm. (auth)

5910 (BARC/I-234) USE OF THE FLUORIDE ION SENSITIVE ELECTRODE. Mahadevan, N.; Sathe, R. M. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 22p. INIS.

Using the Orion fluoride ion electrode, methods have been standardized for the determination of fluoride over a wide concentration range of 10^{-1} M to 10^{-5} M in a variety of samples like water, alkaline distillates, toothpaste and nuclear pure uranium oxide. For fluoride concentration higher than 10^{-3} M, a titration procedure using lanthanum nitrate is preferable. The results compare favorably with those by colorimetry (bleaching of a metal dye complex) or titrimetry with thorium nitrate. In the case of uranium oxide, the fluoride determination can be carried out as such without prior separation. The fluoride electrode has also been used to study the fluorocomplexes of vanadium. The formation curves at two different metal concentrations show good agreement indicating absence of polynuclear species. (auth)

5911 (ETR-254) PLUTONIUM PURIFICATION CYCLE WITH TRIBUTYL PHOSPHATE AS EXTRACTING AGENT. Salomon, L.; Vermeulen, G.; Mertens, L. D.; Leopz de Manterola, J.; Eschrich, H. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Dec 1971. 29p. (In French). INIS.

The difficulties found in a Pu purification cycle by extraction in TBP solution was studied on a laboratory scale. Third phase formation, radiolysis of the solvent, and formation of TBP degradation products in intercycle evaporators concentrating the Pu solutions before their purification are the factors considered. (tr-auth)

5912 (ETR-276) STUDY OF THE LEACHING OF PLUTONIUM OXIDE FOR THE ELIMINATION OF AMERICIUM. Eschrich, H.; Salomon, L. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Feb 1972. 23p. INIS.

The leaching of plutonium oxide powder was studied with respect to the selective elimination of ^{241}Am a daughter product of ^{241}Pu. It was shown that formic acid selectively removes Am with an enrichment factor at least equal to 400. The best conditions are a 1.2M HCOOH leaching solution and an operating temperature of 90°C. The exchange rate of Am between the solid and the solution is low; moreover, after prolonged contact chemical reactions intervene between the solution products and the oxide powder. The maximum quantities of Am extractable from the PuO_2 powder scarcely exceeds 20% of its total content. (tr-auth)

5913 (FOA-4-B-4058) SPECTROPHOTOMETRIC INVESTIGATION OF PLUTONIUM(III) IONS IN AQUEOUS SOLUTIONS OF VARIOUS ACIDS. Halloff, E. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1972. 4p.

An investigation is reported of the absorption spectrum of plutonium(III) ions in aqueous solutions of various acids. The acid concentration was kept constant during all experiments. The media investigated were hydrochloric, nitric, and perchloric acid. To prevent oxidation of plutonium(III) ions, hydroxylamine hydrochloride was added. Molal absorptivity values at the major absorption peaks are given separately for each medium. An investigation was performed to test whether possible shifts in the wavelength of absorption maxima and discrepancies in the molal absorptivities caused by the different anions are significant. The concentration interval of plutonium(III) ions was 0.25 to 5.00 mg per gram of solution. (auth)

5914 (JEN-263) OPTIMIZATION OF THE GAS CHROMATOGRAPHIC SEPARATIONS. Gasco, L. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 42p. (In Spanish). INIS.

A review and a critical study on optimization of gas chroma-

tographic separations are made. After dealing with fundamental gas chromatographic equations, some methods of expressing column performances are discussed: performance indices, performance parameters, resolution and effective plate number per unit time. This is completed with a comparative study on performances of various types of columns. Moreover, optimization methods for operating chromatographic conditions are extensively dealt with: as resolution optimization, separation time, and normalization techniques for the time of analysis in order to achieve the maximum resolution at constant time. Finally, some other non-operating parameters such as stationary phases, column preparation and optimization methods by means of computers are studied. (auth)

5915 (KFK-1941) APPARATUS FOR SODIUM DISTILLATION FOR ANALYTICAL PURPOSES "NADESTAN 4". Borgstedt, H. U.; Peric, Z.; Wittig, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Feb 1974. 19p. (In German). Dep. NTIS (US Sales Only) $4.00.

An apparatus for analytical application of sodium distillation is described. The apparatus "NADESTAN 4" is part of a process chain composed of the sodium sampling by-pass of the sodium loop, the pure atmosphere sodium handling box, and the distillation device itself. The sodium overflow samples collected in nickel crucibles are distilled in a glass vessel separated from the sodium loop. The sodium is evaporated by induction heating. By the process the sodium metal can be separated from the contaminants, which can be analyzed in the residue of the distillation with high sensitivity. The new apparatus is in use for analyses of sodium samples from the high-temperature corrosion loop, the wear test rig and the tank facility for self-welding experiments. The results of oxygen analyses are in good agreement with cold trap temperatures of the loops and with the output of emf oxygen meters operated in the same loops. (auth)

5916 (LA-5490) SPECTROPHOTOMETRIC MEASUREMENT OF URANIUM IN PLUTONIUM DIOXIDE. Koski, N. L.; Gardner, R. D.; Waterbury, G. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

Uranium in plutonium dioxide is measured spectrophotometrically as the Arsenazo-I complex after separation by anion exchange resin in a hydrochloric acid medium. The sample is dissolved in 12M HCl at 300°C in a sealed tube or, alternatively, by repeated fumings with HNO_3-HF-H_2SO_4 mixtures. A sample size of 70 mg permits the determination of 300 to 1100 ppM of uranium with a relative standard deviation of 10%. At the 1400 to 3000 ppM level the relative standard deviation is 5%. The procedure is normally free from interferences. (auth)

5917 (RT/CHI-(74)1) PROGRESS IN STANDARDIZATION OF ANALYTICAL METHODS FOR MATERIALS OF NUCLEAR INTEREST. II. Standard Method for Combustion: Thermal Conductivity Determination of Total Carbon in Steels and Alloys. Castagnola, A. M.; Meloni, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

The combustion–thermal conductivity method of determination of carbon has been revised and standardized for analytical control purposes. The method can be applied to the analysis of total carbon contained in stainless steels, electrolytic iron and titanium-, nickel-, cobalt-, copper- and zirconium-based alloys in the concentration range of 0.007 to 1.2%. A modified method of calculation based on statistical considerations is suggested. The detection limit is 3 micrograms of carbon. The limits for the mean in the range 80 to 100 micrograms of carbon at a probability of 0.05% (5% risk) and with 4–10 degrees of freedom are ±3 to 6%. (auth)

5918 SPECTROPHOTOMETRIC STUDY OF COMPLEX FORMATION AND SOLVATION OF ACTINIDE IONS. VI. Nature of Intermediate Forms of Uranium(IV) and Neptunium(IV) in Nitrate Solutions. Rykov, A. G.; Blokhin, N. B.; Vasil'ev, V. Ya. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 345-349(1973).

Translated from Radiokhimiya; 15: No. 3, 341-347(1973).

The hypothesis is put forward that the change in the absorption spectra of uranium(IV) and neptunium(IV) observed in nitrate solutions of medium concentration is caused not by the formation of inner sphere nitrate complexes of the type $M(NO_3)_4^{4-n}$, but by a change in the structure of the aquo complex of the cation M(IV). A model was examined which relates the change in the structure of the aquo complex of the microcomponent cation to the change in the geometric structure of the solution with an increase in the concentration of nitrate groups. It is shown that this interpretation of the nature of the intermediate forms of uranium (IV) and neptunium (IV) makes it possible to explain the observed relation of the yield of these forms to the concentration of nitrate groups, the acidity of the solution, and the concentration of "neutral" ClO_4^- anions. (auth)

5919 SPECTROPHOTOMETRIC STUDY OF COMPLEX FORMATION AND SOLVATION OF ACTINIDE IONS. VII. Conditions of the Formation of Uranium(IV) Hexanitrate Complex. Rykov, A. V.; Andreichuk, N. N.; Vasil'ev, V. Ya. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 350-355(1973).

Translated from Radiokhimiya; 15: No. 3, 347-353(1973).

The hypothesis that the intermediate forms of uranium(IV), neptunium(IV), and plutonium(IV) ions, which exist in nitrate solutions of medium concentration ("form B"), are the aquo complex $M(H_2O)_4^{4+}$, makes it possible to give a quantitative description of the yield of hexanitrate forms of these elements in concentrated solutions of nitric acid. The proposed model explains the observed dependence of the yield of hexanitrate forms on the stability of the aquo complexes of the macrocomponent cations of the solution. (auth)

5920 SPECTROPHOTOMETRIC STUDY OF THE SYSTEM UO_2^{2+}–SODIUM SALT OF 1-PHENOL-4-SULFONIC-AZO-2-HYDROXYNAPHTHYL ACID. Popa, G. R.; Vladescu-Dinolu, L.; Croitoru, V. An. Univ. Bucuresti, Chim.; 20: No. 1, 109-119 (1971). (In Rumanian).

A spectrophotometric study was made of the complex combination of UO_2^{2+} using Solochrom Violet RS as the organic reagent. The study on the formation of this complex imposed the establishment of better conditions so as to obtain a high stability so that it could be used in spectrophotometric determination of the UO_2^{2+} ion. Among these conditions were the wave length, pH, reagent concentration, reaction time, and temperature. The spectrophotometric method proposed permits, within certain concentration limits, the determination of the UO_2^{2+} ion in the presence of elements having analogous properties or elements often found in its minerals. The molar ratio of the complex obtained was determined as $UO_2^{2+}/R = 1/1$ and the value of the stability constant is $K_s = 1.03 \times 10^9$. (tr-auth)

5921 SPECTROGRAPHIC ANALYSIS OF FIRE ASSAY BEADS FOR THE PLATINUM GROUP METALS AND GOLD. Sim, P. G. (Dept. of Scientific and Industrial Research, Petone, New Zealand). Appl. Spectrosc.; 28: No. 1, 23-25(1974).

By arcing a 10-mg fire assay bead at 7 A on a Cu cathode, bead ejection is avoided without buffering. Sensitivities for the precious metals are in the range 0.01 to 0.5 μg and precisions between 8 and 18%. The technique is suitable for rapid screening of fire assay beads for the precious metals. (auth)

5922 AMPEROMETRIC DETERMINATION OF Zr WITH AZOPYRAZOLONIC DERIVATIVES. Popa, G. R.; Cruceru, D.; Greff, C. An. Univ. Bucuresti, Chim.; 20: No. 1, 65-70(1971). (In Rumanian).

The polarographic behavior of azopyrazolonic derivatives was studied and 1-phenyl-3-methyl-5-hydroxy-4-pyrazolyl-azo-4'-arsanilic acid was proposed for the amperometric determination of Zr. (tr-auth)

5923 SPECIFIC TRAITS OF OXIDATIVE DECOMPOSITION OF ORGANORUTHENIUM COMPOUNDS AND THEIR USE IN ELEMENTAL ANALYSIS. Gel'man, N. E.; Egorova, A. G.; Sheveleva, N. S. (Inst. of Heteroorganic Compounds, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 22: No. 8, 1878(Aug 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 22: No. 8, 1921(Aug 1973).

It was established that Ru does not form the volatile tetraoxide during the thermal decomposition of organoruthenium compounds in an O_2 atmosphere at <700°, but instead is liberated in a nonvolatile form, as a mixture of the dioxide and the metal, and can be concentrated quantitatively in a small localized decomposition zone. Because of the catalytic action of Ru, the quantitative destructive oxidation of organoruthenium compounds is achieved under comparatively mild conditions. This makes it possible in elemental analysis to separate Ru from elements that form volatile oxidation products. The latter can be retained separately by the proper absorbent, or they can be condensed outside the decomposition zone. The simultaneous gravimetric microdetermination of Ru, C, and H in ruthenocene and six of its derivatives containing C, H, N, O, and Ru was accomplished. (LK)

5924 SPECTROPHOTOMETRIC STUDY OF THE REACTION OF Zr WITH 2-HYDROXY-5-NITROBENZENE-AZO-2-NAPHTHOL. Popa, G. R.; Cruceru, D.; Nicolescu, I. An. Univ. Bucuresti, Chim.; 21: No. 2, 9-16(1972). (In Rumanian).

The reaction of Zr ions with 2-hydroxy-5-nitrobenzene-azo-2-naphthol was studied. The complex formed has an absorption maximum at 560 nm and it is stable in acid medium. The ratio of reagent/Zr is 1:1 and the instability constant is estimated as

2.5×10^{-3}. The reagent can be used to determine Zr between 0.8 to 10 g Zr/ml. Complexing anions interfere with the reaction. Zr can be determined in the presence of small quantities of Th and UO_2^{2+}. (tr-auth)

5925 EMISSION SPECTROSCOPY FOR RARE-EARTH ANALYSES AND FOR THE DETERMINATION OF IMPURITIES IN RARE-EARTH MATERIALS. DeKalb, E. L. (Ames Lab., IA). pp 61-70 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

Emission spectroscopy is the primary and most powerful analytical tool for the chemical analysis of rare-earth materials, and for the determination of rare-earth impurities in other materials. However, many rare-earth elements have a complex emission spectrum, so that spectral equipment and analytical procedures must be selected with care. Rare earth analyses can be classified into four broad categories: (1) the determination of rare earths in a "pure" rare earth; (2) the determination of other impurities in a rare earth; (3) the determination of rare earths in a mixture of various rare earths; and (4) the determination of rare-earth impurities in other materials. Each of these four types of analyses presents the spectroscopist with unique problems which may be solved in several ways. The present state-of-the-art, as measured by detection limits, is reviewed for the first two categories. (auth)

5926 FLAME AND PLASMA ATOMIC ABSORPTION, EMISSION AND FLUORESCENCE SPECTROSCOPY OF THE RARE-EARTH ELEMENTS. Fassel, V. A.; Kniseley, R. N.; Butler, C. C. (Ames Lab., IA). pp 71-86 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

In comparison to the very complex spectra emitted by the rare-earth elements in arc or spark discharges, their corresponding flame emission spectra are relatively simple. Historically, the first analytical applications of flame emission spectra utilized observations on the rare-earth monoxide band systems, which constitute the principal spectral features in the spectra emitted by non-reducing flames. Because of the spectral overlap of the band systems, their analytical utility was rather limited. The observation that fuel-rich O_2-C_2H_2 or N_2O-C_2H_2 flames provided a striking increase in the atomization efficiency, and hence a greater free-atom population in the flames, greatly broadened the scope of application of flame spectroscopy. The enhancement factors in the line emission spectra achieved by simply changing the stoichiometry of either O_2-C_2H_2 or N_2O-C_2H_2 flames are typically several orders of magnitude. Flame emission generally exhibits greater powers of detection than atomic absorption measurements by factors ranging from 2 to 80. As a consequence, flame emission spectroscopic techniques have found a wider application, at least in the Ames Laboratory, to the analysis of rare earth mixtures and to the determination of low concentrations of the rare earth elements. Although the ultimate potential of electrically generated "flame-like" plasmas has not been evaluated, the preliminary results so far obtained suggest that these plasmas may replace combustion flames as excitation sources for the analysis of rare-earth mixtures. (auth)

5927 TRACE ELEMENTS CHARACTERIZATION IN Y_2O_3 BY MASS SPECTROSCOPY AND ISOTOPIC DILUTION. Haaland, J.; Stijhoorn, D. E. (Inst. for Atomenergi, Kjeller, Norway). pp 153-164 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

Rare-earth elements at concentrations down to 0.1 ppM have been determined in pure yttrium oxides using isotopic dilution and the ATLAS CH4 single-focusing instrument with a double rhenium filament ion source. The eight poly-isotopic elements were determined in one run after addition of a master-spike. Oxide peaks from the lighter elements were removed effectively by passing benzene through the source. The AEI MS 702 double-focusing spark source mass spectrometer with photographic registration was used to give a general survey of the distribution of both RE and non-RE elements. The Y_2O_3 samples were mixed with 60% pure graphite to make them conducting and pressed into a pair of tiny electrodes. A series of spike isotopes were again mixed in for calibration. A simplified plate calibration procedure was used. The peaks of the spike isotopes served for quantitative determinations, either by isotopic dilution or by precalculated sensitivity factors for other elements. A background spectrum from carbon, yttrium carbide, etc. interferes in some cases with analysis lines. The general limit of determination is also in this case 0.1 ppM. (auth)

5928 TRACE SUBSTANCES IN ENVIRONMENTAL HEALTH. Proceedings of University of Missouri's 7th Annual Conference, Columbia, Missouri, June 12–14, 1973. Hemphill, D. D. (ed.). Columbia, MO; University of Missouri (1973). 474p. (CONF-730613-).

Separate abstracts were prepared for 7 of the 56 papers presented in these proceedings. The other 49 papers are arranged under the following main headings: epidemiology; environmental geochemistry and health; environmental pollution; health effects of trace substances; and analytical methodology. (ERB)

For abstracts of individual papers see: 5868, 5929, 5930, 5954–5956, and 7175.

5929 TRACE ELEMENTS IN HUMAN DENTAL ENAMEL. Losee, F. (Eastman Dental Center, Rochester, NY); Cutress, T. W.; Brown, R. pp 19-24 of Trace Substances in Environmental Health. Hemphill, D. D. (ed.). Columbia, MO; Univ. of Missouri (1973).

From seventh annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973). See CONF-730613-.

This paper reports on the occurrence and concentrations of 68 elements in 56 enamel samples obtained from persons raised in widely differing geographic areas. Each enamel sample was analyzed separately by spark source mass spectrometry. Minor elements occurring in greatest concentration (>10 μg/g dry wt) were F, Si, S, K, Zn and Sr. Others analyzed were Li, B, Al, Fe, Mo, Ba and Pb (1-10 μg/g), Ti, Cr, Mn, Ni, Cu, Se, Br, Rb, Zr, Nb, Cd, Sn and Sb (0.1-1.0 μg/g); Be, V, Co, Y, Ag, I, Cs, La, Ce, Pr, Nd and Bi were found at very low concentrations, less than 0.1 μg/g. Thirty elements were not detected. It was concluded that 43 elements are incorporated as regular constituents of developing human dental enamel and the data presented could act as a comparative base-line in future trace element enamel studies. (auth)

5930 COMPARISON OF INTRA- AND INTERHEPATIC VARIABILITY OF TRACE METAL CONCENTRATIONS IN NORMAL MEN. Perry, H. M. Jr.; Perry, E. F.; Purifoy, J. E.; Erlanger, J. N. (Washington Univ., St. Louis). pp 281-288 of Trace Substances in Environmental Health. Hemphill, D. D. (ed.). Columbia, MO; Univ. of Missouri (1973).

From seventh annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973). See CONF-730613-.

Tissue concentrations of essential and non-essential trace elements in man have been widely reported with varying degrees of agreement from laboratory to laboratory. In an attempt to determine what part of the difference in values results from systematic differences within the liver and what part from random variation the concentrations of Ag, Al, V, Cd, Co, Cr, Cu, Fe, Pb, Mn, Mo, Ni, Sn, Sr, Ti, and Zn were determined spectrographically for ten relatively precisely defined regions of ten livers obtained from subjects who died sudden accidental deaths. Wet weight, dry weight, ash weight, and nitrogen content were determined for all samples. The results of the analyses were then investigated in the following ways. First, variations in metal content between various sites within the same liver were examined to determine if metals were equally distributed throughout the organ or whether there were systematic variations from one region to another. Second, in a search for the optimum frame of reference for reporting results the use of ash weight, dry weight, wet weight, or nitrogen content was studied. Choice of sampling site proved to be relatively unimportant within the liver, the variability between livers being much greater than the variability between sites within the same liver. The inter-hepatic variability was highly significant for all metals with $p < 0.01$, but only for Ba and Sr was there significant intra-hepatic variability. Ash weight proved to be better than dry weight, wet weight, or nitrogen as a frame of reference producing the lowest residual variance in a test for rank order for 12 out of 16 metals. (auth)

5931 DIRECT SPECTROPHOTOMETRIC DETERMINATION OF IODATE FOLLOWING PERIODATE OXIDATION OF α-GLYCOL GROUPS: QUANTITATIVE REMOVAL OF IODATE AND PERIODATE BY ION-EXCHANGE MATERIALS OR BY SOLVENT EXTRACTION. Khym, J. X. (Oak Ridge National Lab., TN). Methods Carbohyd. Chem.; 6: 87-93(1973).

Sodium iodate, present in amounts corresponding stoichiometrically to those of the α-glycol moiety of a carbohydrate oxidized by IO_4^-, may be determined spectrophotometrically at 232 nm after removal of unconsumed IO_4^- by ion exchange. For samples with low Cl^- concentration a strongly basic polystyrene anion-exchange resin (acetate form) is used, the IO_3^- being eluted with 0.1M-NH_4Cl;

an alumina column is used if the Cl^- concentration is high, the IO_3^- then being eluted with 0.2M $K_2B_4O_7$. An alternative procedure involves extraction of the IO_4^- from solution with 5% Aliquat 336 solution in Freon-TF, after which the IO_3^- are determined from the extinction of the aqueous solution. (Anal. Abstr.)

5932 RECOVERY OF ZIRCONIUM METAL BY FUSED SALT ELECTROLYSIS. Pint, P. Toronto; Univ. of Toronto (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

A high temperature electrolytic zirconium deposition process was discovered whereby zirconium metal could be deposited at reasonable current efficiencies in molten chloride baths containing NaCl-KCl or preferably CsCl as the solvent and Cs_2ZrCl_6 as the solute. Variables that affect the deposition process such as the temperature of the electrolyte, bath composition, current density, cell potential, concentration polarization, electrode material and electrode geometry, were investigated. Based on the characteristics of the deposit, the apparent cathode current efficiencies and the properties of the electrolyte it was shown that the best zirconium deposits, which may be described as dense, coherent, fine grained, thick, and shiny can be obtained from electrolytic baths containing CsCl and Cs_2ZrCl_6. The complexing properties of the solvent, which result in a low activity for soluble $ZrCl_4$, play an important role in determining the success of this industrially promising deposition process. The method on which the present process is based should also be applicable to electrodeposition of other reactive metals like Ti, Hf, Nb, and Ta, which form volatile tetrachlorides. (LK)

5933 ABSORPTION SPECTRA OF AMERICIUM(III) AND NEODYMIUM(III) IN MOLTEN PYRIDINIUM AND ALKALI METAL CHLORIDES. Barbanel, Yu. A.; Kotlin, V. P.; Klokman, V. R. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 368-373(1973).

Translated from Radiokhimiya; 15: No. 3, 366-372(1973).

A procedure was developed for measuring absorption spectra in melts by means of an SF-8 recording spectrophotometer (by a double-beam system up to 400°C and by a single-beam system up to 1000°C). A study was made of the spectra of Am(III) and Nd(III) in molten alkali metal chlorides and also the spectra of Am(III), Nd(III), and Pr(III) in a melt of PyHCl; the latter were identified as the spectra of octahedral complexes of the type MCl_6^{3-}. It was established that there is an increase in the fraction of americium present in the form of the octahedral complex $AmCl_6^{3-}$ in the series: LiCl–KCl (eut) < NaCl–KCl (1 : 1) < NaCl–RbCl (eut) < NaCl–CsCl (eut) < CsCl; an increase in the fraction of $NdCl_6^{3-}$ was demonstrated for the series: LiCl–KCl (eut) < NaCl–KCl (1 : 1) < NaCl–CsCl (eut). It was suggested that the forms in which Am(III) and Nd(III) exist in chloride melts that are in equilibrium with $AmCl_6^{3-}$ and $NdCl_6^{3-}$ have a coordination number >6. (auth)

5934 QUANTITATIVE SPECTROCHEMICAL ANALYSES OF FELDSPARS BY ION BOMBARDMENT. Tsong, I. S. T.; McLaren, A. C. (Monash Univ., Clayton, Australia). Nature (London); 248: No. 5443, 43-45(1 Mar 1974).

Analyses were made by comparing the intensities of the emission lines of the major constituents. It was assumed that diffusion did not occur to an appreciable extent, so that the relative sputtering rates were directly proportional to the atomic concentrations in the target, and that self absorption was negligible. The emitted light was analyzed by a grating monochromator, with a cooled photomultiplier as detector, and the intensity was measured by a standard AC chopping technique. Details are given of the analysis procedure, and results are shown tabulated for Si, Al, Fe, Ca, Na, and K. Electron microprobe analyses are also shown, for comparison purpose, and results were in good agreement. Among advantages of the method are the following: the apparatus costs considerably less than other comparable analytical instruments; multi-element analysis is easy to carry out and no elaborate sample preparation is required; light elements down to H can be detected; as the method essentially carries out surface analysis it can be used to determine the concentration profile in a solid as successive surface layers are sputtered away; the line spectra contain very few lines compared to ordinary spectrochemical analysis by arc discharge, making identification of elements a rapid and easy process. A new apparatus using a duoplasmatron ion source to deliver a stable and high current density ion beam, and a multiple-target specimen chamber to facilitate rapid and direct comparison of intensities, are under construction for improved performance. (UK)

5935 COMPLEXOMETRIC DETERMINATION OF MOLYBDENUM IN FERROMOLYBDENUM. Poljakova, K.; Cakon, M. (Research Inst. NHKG, Ostrava, Czech.). Hutn. Listy; 27: No. 10, 743-745(1972). (In Czech).

The sample is dissolved in dilute H_2SO_4 (1 : 10) and aqueous H_2O_2 (30%), and interfering elements are separated by means of NaOH or KOH. Molybdenum is reduced to Mo(V) with hydroxylammonium chloride, then excess EDTA solution is added and unreacted EDTA is determined titrimetrically. Interference by Al is avoided by addition of F^-; V causes positive errors and a photometric determination of this element is carried out and its amount deducted from that obtained for Mo. The method is suitable for samples containing 16 to 70% of Mo. (Anal. Abstr.)

5936 TRACE ELEMENT ANALYSIS OF SEAWATER AND FISH SAMPLES BY PROTON INDUCED X-RAY EMISSION SPECTROSCOPY. Alexander, M. E.; Biegert, E. K.; Jones, J. K.; Thurston, R. S.; Valkovic, V.; Wheeler, R. M.; Wingate, C. A.; Zabel, T. (Rice Univ., Houston, TX). Int. J. Appl. Radiat. Isotop.; 25: No. 5, 229-233(May 1974).

Proton-induced x-ray emission spectroscopy has been used for trace element analysis of seawater and fish (trout-Salmo gairdneri) samples. To test the applicability of the technique for large scale-analysis of seawater and fish samples, the consistency of results from equivalent samples was checked. Also, a volatilization study was made at several different beam intensities to determine the effects of the beam on trace elements in the samples. The reproducibility of the results was found to be within acceptable limits. (auth)

5937 SPECTROPHOTOMETRIC DETERMINATION OF ALUMINUM AND BERYLLIUM WITH METHYLXYLENOL BLUE. Ueda, J. (Kanazawa Univ., Japan). Nippon Kagaku Kaishi; 1974: No. 2, 273-279(Feb 1974). (In Japanese).

Methods for the spectrophotometric determination of aluminum and beryllium with methylxylenol blue (MXB) have been studied. Aluminum produced a water-soluble red-violet complex with MXB. The absorption maximum of the colored solution occurred at 578 to 583 nm, and the absorbance was constant over the pH range from 2.2 to 2.5. The relation between the absorbance of the complex and the concentration of aluminum was linear over the range of 8 to 35 μg Al/25 ml, and the sensitivity for log (I_0/I) = 0.001 was 0.0016 μg Al/cm^2 at concentration of 20 μg Al/25 ml. The mole ratio of aluminum and MXB was found to be 1 : 1 at pH 2.4 by the method of continuous variation. Among the forty-two diverse ions examined, gallium, indium, bismuth(III), scandium, thorium, iron(III), fluoride and oxalate interfered with the determination, but the effect of iron(III) could be eliminated by the addition of ascorbic acid. MXB reacted with beryllium to form a water-soluble red complex and its aqueous solution had an absorption maximum at 513 to 517 nm with a constant absorbance at pH 5.9 to 6.5. The solution containing up to 10 μg/25 ml of beryllium obeyed the Beer's law and the sensitivity of the determination was 0.0008 μg Be/cm^2 for log (I_0/I) = 0.001. The mole ratio of beryllium to this reagent in the complex was 1 : 1. Many ions interfered with the determination, but some of them such as lead, bismuth(III), zinc, rare-earth elements, iron(III) and cobalt could be masked by the addition of a small amount of EDTA. Aluminum, thorium, chromium(III) and fluoride, however, interfered seriously. As aluminum could be determined at pH 6.0 and at a wavelength 515 nm, consecutive determination of aluminum and beryllium has been also studied. A sample solution containing aluminum and beryllium was divided equally. From one solution, aluminum was determined at pH 2.4 and 580 nm. From another solution, beryllium was determined by the difference of absorbances at pH 6.0 and 515 nm, where the absorbances due to the two metal complexes were additive. (auth)

5938 SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM WITH 2(2-THIAZOLYLAZO)-5-DIMETHYLAMINOPHENOL IN THE PRESENCE OF TRIETHANOLAMINE. Tsurumi, C. (Shibaura Inst. of Tech., Tokyo); Mitsuhashi, H.; Furuya, K.; Fujimura, K. Jap. Anal.; 23: No. 2, 143-147(Feb 1974). (In Japanese).

A method of the spectrophotometric determination of small amounts of niobium with 2-(2-thiazolylazo)-5-dimethylaminophenol (TAM) in the presence of triethanolamine (TEA) solution is described. The niobium-TAM complex is blue-violet in an acidic aqueous solution and is stable for 45 minutes up to 6 hours. The absorbance is constant in a pH range of 3.2 to 3.8. The complex of niobium shows an absorption maximum at 603 nm and the molar extinction coefficient at this wavelength is estimated to be 4.8×10^4. The sensitivity for niobium is 1.9×10^{-3} μg/cm^2 per 0.001 of absorbance. The complex of niobium is extremely stable and is obeyed to Beer's law up to 1.2 μg/ml of niobium. The molar ratio of niobium to TAM in the complex was confirmed to be a 1 : 1 ratio by the method of continuous variation. Titanium(IV), copper(II), aluminum(III), zirconium(IV), iron(III), and carbonate ions interfered with the determination of niobium by decreasing the absorbance. For the determination of niobium in steel, take 0.1 to 0.5 g of stainless steel into a 200-ml teflon beaker, and 5 ml of aqua regia and dissolve by heating on a water bath. Transfer the solution to a separating funnel with a small amount of water, and remove interfering elements by extracting with methyl isobutyl

ketone from 7 N hydrochloric acid solution in the presence of nitric acid. After the treatment of the aqueous solution with sulfuric acid, the solution was made up of 500 ml with water. An aliquot of the solution is used for the spectrometry described above. The coefficients of variation by the present method were 1.4% and 3.6% for stainless steel and carbon steel, respectively. (auth)

5939 COMPLEXOMETRIC DETERMINATION OF MOLYBDENUM BY POTENTIOMETRIC TITRATION. Nonova, D.; Gesheva, M. (Univ., Sofia). God. Sofii. Univ., Fiz. Fak.; 64: 213-220(1972). (In Bulgarian).

The solution containing 5 to 100 mg of Mo(VI), is acidified with 10 ml of 6N HCl before adding an excess of EDTA and ≈1 g of hydrazinium sulfate to produce a Mo(V)-EDTA complex. Unreacted EDTA is determined by titration with $FeCl_3$ solution at pH 1.5 to 2 with potentiometric indication of the end-point. The average error is ≈1.5%, with a standard deviation between 0.22 and 0.47 mg. (Anal. Abstr.)

5940 STUDIES IN REDUCTION WITH VANADIUM(II). Part III. Potentiometric Titration of Molybdenum(VI) with Vanadium (II) in Presence of Manganese(III) and Cerium(IV). Akinchan, N. T. (Inst. of Tech., Muzaffarpur, India); Prasad, S. N. J. Indian Chem. Soc.; 50: No. 7, 449-451(Jul 1973).

Potentiometric titration of Mo(VI) in presence of Ce(IV) or Mn(III) against V(II) has been performed in the atmosphere of nitrogen and in this case, the presence of phosphoric acid is not essential for fast reaction. Potential breaks indicate that effective reduction of Mo(VI) takes place along with V(IV) formed as the intermediate product. Between 7 and 12 N sulfuric acid Mo(VI) is reduced to Mo(III) and between 2 to 6 N it is reduced to Mo(V). Mo(VI) can be quantitatively and easily reduced at ordinary temperature if Mn^{2+} or Ce^{3+} ions in small quantity are used as a catalyst. In this case, two potential breaks are obtained between 7 to 12 N sulfuric acid corresponding to Mo(V) and Mo(III) and only one break between 2 to 6 N which corresponds to Mo(V). Below 2 N sulfuric acid titrations are not possible, probably due to formation of molybdenum blue. (auth)

5941 INDIRECT DETERMINATION OF LANTHANUM IN A MIXTURE OF RARE EARTH OXIDE. Tomida, Y.; Takada, K. I.; Funasaka, W. (Kyoto Univ.). Jap. Anal.; 23: No. 1, 86-88(Jan 1974). (In Japanese).

Lanthanum in a mixture of rare earth oxide, consisting of the elements of cerium and yttrium groups, was determined indirectly by using a combination of gravimetric, volumetric and colorimetric procedures. The two groups were separated from each other by the double sulfate method, and the rare earth elements of the cerium group were determined by weighing the oxide. In addition to lanthanum and cerium, the cerium group contained praseodymium, neodymium and samarium, which were determined colorimetrically by utilizing their sharp absorptions at 444.5 nm, 521.8 nm and 401.5 nm, respectively. Cerium was determined volumetrically by the method of JIS 8404 without group separation. The lanthanum content was calculated by the equation $La_2O_3(\%)$ = Cerium group rare earth oxide(%), $La_2O_3(\%) = -CeO_2(\%) - Pr_6O_{11}(\%)$, $La_2O_3(\%) = -Nd_2O_3(\%) - Sm_2O_3(\%)$. The results obtained showed good precision, and were in fairly good agreement with those by the x-ray fluorescence method. It suggests that at the stage of the group separation the lanthanum and cerium in the sample were completely precipitated as their double sulfates and all the yttrium group elements were removed from the precipitate. The method reported here is expected to be generally applicable to the determination of lanthanum in a mixture of rare earth oxides which consists mainly of cerium group elements. (auth)

5942 MECA SPECTROSCOPY-A NEW FLAME ANALYTICAL TECHNIQUE. Belcher, R.; Bogdanski, S.; Ghonaim, S. A.; Townshend, A. (Univ. of Birmingham, Eng.). Anal. Lett.; 7: No. 2, 133-146(1974).

A review is presented of molecular emission cavity analysis (MECA) spectroscopy. The technique is described, and applications to the determination of trace concentrations of a wide range of non-metals are outlined. (auth)

5943 DIRECT SPECTROGRAPHIC DETERMINATION OF BORON IN UF_4. Murty, P. S.; Marathe, S. M.; Bai, K. P. B. (Bhabha Atomic Research Center, Bombay). Anal. Lett.; 7: No. 2, 147-151(1974).

A method for the direct spectrographic determination of boron in uranium tetrafluoride, using d.c. arc excitation is described. Observations made on the choice of arc current, exposure time and the electrode type are presented. The sensitivity obtained for boron using B 2497.7 Å by the present method is 0.07 ppM. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 6119, 6192, 6541, 6604, 6621, 6678, 6698, 6699, 6725, 6729-6732, 6739, 6741, 6787, and 6789.

5944 (ANL-8004) APPLICATION OF X-RAY FLUORESCENCE TO ON-LINE ANALYSIS OF PLUTONIUM IN MIXED-OXIDE FBR FUELS. Schnizlein, J. G.; Gerding, T. J.; Steindler, M. J. (Argonne National Lab., Ill. (USA)). Feb 1974. Contract W-31-109-eng-38. 56p. AT.

X-ray fluorescence (XRF) analysis was demonstrated to be an effective, nondestructive, analytical method for determining U/Pu ratios in UO_2-PuO_2 pellets over the compositional range from 20 to 30 wt % PuO_2 in UO_2. This analytical technique has potential application as an automated, on-line analytical method for fuel fabrication plants. The study reported here consisted of two parts. In the first, ThO_2-UO_2 was used as a stand-in for UO_2-PuO_2 to gain information on the effect of various parameters and to determine the procedures to be used with UO_2-PuO_2 while avoiding the hazards and additional time required in handling plutonium compounds. Powders, green pellets, and sintered pellets were analyzed and the results are reported. In the second part of the study, UO_2-PuO_2 green pellets and sintered pellets were analyzed by XRF and the results obtained indicate that the U/Pu ratios can be determined with a relative standard deviation of less than ±0.5%. Effects of composition, density, and particle size were measured experimentally and the results are discussed. Other error sources are presented and described. (auth)

5945 (BARC/I-135, pp 81-87) GAMMA ABSORPTIOMETRY FOR URANIUM. Bhargava, V. K.; Rao, V. K.; Chandrasekharan, E. S.; Iyer, R. H.; Ramaniah, M. V.; Srinivasan, N. (Bhabha Atomic Research Centre, Bombay). 1971.

As a part of development work for the in-line analysis of fuel reprocessing streams, a gamma absorptiometric technique was developed to continuously assay uranium and plutonium. ^{241}Am has been chosen as a gamma source because of its long half-life (470 y) and low monoenergetic gammas (60 keV), which permit discrimination against the constituents of low atomic number such as $Al(NO_3)_3$, HNO_3 etc. The design of the gamma absorptiometer with the absorption cell, the radiation detector and the electric readout system is described. The results indicate that (i) the interference in the determination of uranium due to light element constituents such as HNO_3, H_2O_2, $Al(NO_3)_3$, TBP etc. is very small, (ii) uranium content in the concentration range 10-350 g/l is determined with an accuracy of 2.5% at higher concentrations and 5.8% at lower concentrations (< 25 g/l of U) and (iii) the acidity of solution does not have any effect on the results. (INIS)

5946 (EGU-5120702) GAS RADIOCHROMATOGRAPHY IN ACTIVITY CONTROL AT NUCLEAR POWER PLANTS AND ISOTOPIC ANALYSIS BY GAMMA SPECTROMETRY. Kapisovsky, V. (Vyskumny Ustav Energeticky, Jaslovske Bohunice (Czechoslovakia)). 1972. 105p. (In Slovak). INIS.

The methods of gas radiochromatography and of semiconductor gamma spectrometry are discussed. The automatic chromatographic analyzer for the determination of argon, krypton and xenon activities is described. The test results and the experimental value of the detector sensitivity are presented. A description of the gamma spectrometry system is presented and methods for the manual and automatic spectra evaluation are given. A program is presented for the determination of the parameters of the total absorption peaks, and the conversion of the parameters into energy and intensity values of the registered gamma radiation is discussed. A model for the identification of radioisotopes based on the application of the least-square method is described. (auth)

5947 (INPT-44) POSSIBILITIES OF RADIOMETRIC DETERMINING ELEMENTARY SULFUR CONTENT IN MULTICOMPONENT ORES. Dziunikowski, B.; Gazda, A. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). 1973. 21p. (In Polish). Dep. NTIS (US Sales Only) $4.25.

Possibilities are discussed for rapid radiometric determination of elementary sulfur in ore samples when the ore contains as well the sulfur in compounds, for example strontium and barium sulfates. The method suggested is based on measurements of Ca K, Sr K and Ba K x-ray intensities. For obtaining the results of the analysis two nomograms made by the use of standard samples are applied. The proposed method has been verified on the artificial samples being composed of $CaCO_3$, $SrSO_4$, $BaSO_4$ and S.

5948 NUCLEAR MICROANALYSIS USING MeV CARBON ION BACKSCATTERING: USEFULNESS AND APPLICATIONS. Abel, F.; Amsel, G.; Bruneaux, M.; Cohen, C.; Maurel, B.; Rigo, S.;

Roussel, J. (Ecole Normale Superieure, Tour, France). J. Radioanal. Chem.; 16: No. 2, 587-603(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The amplitude-energy relationships for surface barrier detectors were measured for ^{4}He and ^{12}C particles, as well as the corresponding energy resolutions. It is shown that the use of ^{12}C beams presents no marked advantage for increasing mass or depth resolution. On the other hand, pile-up phenomena are drastically reduced by using ^{12}C backscattering. Applications are shown to the determination of trace amounts of Sb or Yb near the surface of iron. Gold contaminations of silicon surfaces were precisely measured within minutes down to $5 \cdot 10^{11}$ gold atom/cm^2, the limiting sensitivity being of the order of 10^{10} atom/cm^2 for traces of heavy elements, such as Au, Hg, Pb, etc. Sensitivities for lighter elements are discussed. (auth)

5949 X-RAY FLUORESCENCE ANALYSIS OF RARE-EARTH ELEMENTS. Bonnevie-Svendsen, M.; Follo, A. (Institut for Atomenergi, Kjeller, Norway). pp 87-107 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

X-ray fluorescence analysis is used for the direct determination of rare-earth elements in rock samples, minerals, rare earth concentrates, products and process solutions. Only a minimum of sample pretreatment is required. Solid samples are mostly powdered and measured as briquets. Liquid samples can be measured as received, but for larger series of process samples a filter technique is preferred. The x-ray spectra are much simpler than optical spectra, and experience shows that essentially interference-free first or second order lines can be found for most rare-earth elements in practically all types of rare-earth mixtures. X-ray fluorescence is a rapid and precise method, but careful precautions are required to avoid errors caused by general or selective absorption--enhancement effects. There is a variety of modes to correct for these effects. The use of internal standards, calibration curves, spike and dilution methods as well as cross-checking with other methods is discussed and illustrated by examples. (auth)

5950 TRACE LEVEL RARE-EARTH DETERMINATIONS BY X-RAY EXCITED OPTICAL FLUORESCENCE (XEOF) SPECTROSCOPY. Fassel, V. A.; DeKalb, E. L.; D'Silva, A. P. (Ames Lab., IA). pp 109-122 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

X-ray excited optical fluorescence (XEOF) has emerged during the past decade as a remarkably sensitive technique for the detection and quantitative determination of rare-earth impurities in a variety of matrices. Although not all aspects of the excitation phenomena are understood, the basic mechanism apparently involves the generation of secondary excitants by the incident x-ray quanta followed by the highly selective transfer of the energy residing in the excitants to rare-earth ion impurities. Although some metallic oxides serve as analytically useful hosts, it is often necessary to convert the sample into a chemically different but effective host system. Ternary and quaternary oxide systems and some phosphates provide detectability of rare-earth impurities in the 1 in 10^9 concentration range. The classical internal reference (standard) principle effectively compensates for the enhancement and depression effects on the fluorescent intensities induced by changing concentrations of other residual impurities in the sample. To date, activated fluorescence of trace rare-earth impurities has been verified in hosts prepared from 55 elements in the periodic system. These observations portend an increasing use of XEOF as a general analytical technique for the ultratrace determination of the rare earth elements. A selected number of applications of XEOF to the determination of residual rare earth impurities in fertile nuclear materials and in highly purified rare earth compounds will be discussed. (auth)

5951 ELEMENTAL ANALYSIS OF AEROSOLS USING PROTON SCATTERING. Nelson, J. W.; Williams, I.; Johansson, T. B.; Van Grieken, R. E.; Chapman, K. R.; Winchester, J. W. (Florida State Univ., Tallahassee). IEEE (Inst. Elec Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 618-621(Feb 1974).

From twentieth nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Elemental analysis for all of the light elements up through chlorine by elastic scattering of 16-MeV protons has been shown to be feasible. Basic problems associated with such measurements are discussed including kinematics, angular distribution, and sample backings. Spectra are presented for air particulate matter for both a total filter (Nuclepore) and a size fractionated air impactor (polystyrene backed) sample. The method is absolute, nondestructive and can be used in conjunction with proton-induced x-ray fluorescence to quantitatively analyze all elements in the same sample in minutes of time. (auth)

5952 VERY-LOW-LEVEL ^{210}Po DETERMINATION IN AIRBORNE DUSTS. Abe, M.; Abe, S. (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo); 22: No. 12, 690-693(Dec 1973).

The recoveries of very low level ^{210}Po in airborne dusts by an electrochemical displacement treatment were determined. Two methods were used here, the one is a direct method by the use of natural ^{210}Po and the other is a tracer method. Both recoveries determined by two methods agreed well with each other. The recoveries of ^{210}Po at 10^{-12} and 10^{-13} Ci in airborne dusts could be considered as being better than 90%. The values are similar to the ones at higher levels. (auth)

5953 RAPID METHOD FOR COLLECTING AND ASSAYING GRADIENT FRACTIONS FOR RADIOACTIVE MACROMOLECULES. Rubinstein, L.; Rein, A. (Litton Bionetics Inc., Bethesda, MD). Biochem. J.; 137: No. 1, 131-133(Jan 1974).

A rapid method is described for collecting gradients after centrifugation, and assaying them for acid-precipitable radioactivity. An entire gradient is collected and processed on a single glass-fibre filter disc. This method allows one easily to assay six gradients for acid-precipitable radioactivity in less than 2 h. (auth)

5954 SIMPLE, QUANTITATIVE X-RAY FLUORESCENT ANALYSIS FOR TRACE ELEMENTS. Sparks, C. J. Jr.; Cavin, O. B.; Harris, L. A.; Ogle, J. C. (Oak Ridge National Lab., TN). pp 361-368 of Trace Substances in Environmental Health. Hemphill, D. D. (ed.). Columbia, MO; Univ. of Missouri (1973).

From seventh annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973). See CONF-730613-.

The application of x-ray fluorescence analysis (XRF) for the determination of trace elements offers cheap, rapid, quantitative analysis without time-consuming prior chemical concentration or alterations. The x-ray fluorescent system presented here uses a monochromatic source of x rays and a solid-state detector energy analyzing system capable of detection limits below 1 ppm by weight for heavy elements to 10 ppm for lighter elements in a variety of samples of interest to the environmentalist. Monochromation by diffraction gives a monoenergetic source for excitation and so improves detectability compared with the systems using white radiation or transmission target x-ray tubes. Direct calculations of elemental concentrations without preparation of standards or known additions is possible with monochromatic x rays at precisions comparable with other techniques. A description of the XRF unit and examples of its application for quantitative analysis are given. Techniques under development for the detection of trace elements to a few parts per billion (ppb) are described. (auth)

5955 TRACE ELEMENT ANALYSIS FOR THE ENVIRONMENTAL BASELINE STUDIES OF THE NAVAJO--KAIPAROWITS GENERATING STATIONS. Mangelson, N. F.; Allison, G. M.; Eatough, D. J.; Hill, M. W.; Izatt, R. M.; Christensen, J. J.; Murdock, J. R.; Nielson, K. K.; Welch, S. L. (Brigham Young Univ., Provo, UT). pp 369-377 of Trace Substances in Environmental Health. Hemphill, D. D. (ed.). Columbia, MO; Univ. of Missouri (1973).

From seventh annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973). See CONF-730613-.

Environmental baseline studies are being conducted in the immediate region of the Kaiparowits and Navajo generating stations. These two large stations which will receive power from combustion of coal are located near the shore of Lake Powell in southern Utah and northern Arizona. Baseline studies are being conducted in order to allow assessment in the future of whether the stations will have chemical or physical effects on the ecosystem of the region. Two years of field work have now been completed. Biological, meteorological, and physical data were collected at each study site. In addition to these data, samples of soil, ground water, plants and animals have been collected and will be analyzed for trace element content. The most extensive work to date has involved the sampling and analysis of soil. A technique has been developed for estimation of available trace elements using a modified Morgan type acetic acid extraction. The sample is analyzed using charge-particle x-ray fluorescence. As many as 15 to 20 elements can be determined during one measurement. Samples as small as 100 mg may be used and a minimal amount of sample preparation is required. Data analy-

sis is easily carried out automatically or semi-automatically. The x-ray fluorescence method is not, however, sufficiently sensitive for all elements of interest and therefore concentrations of some elements are determined by other methods, notably atomic absorption spectroscopy. (auth)

5956 DETERMINATION OF TRACE AMOUNTS OF FLUORINE BY NUCLEAR INELASTIC SCATTERING. Rudolph, H.; Kraushaar, J. J.; Ristinen, R. A.; Meglen, R. R. (Univ. of Colorado, Boulder). pp 387-393 of Trace Substances in Environmental Health. Hemphill, D. D. (ed.). Columbia, MO; Univ. of Missouri (1973).

From seventh annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973). See CONF-730613-.

The detection of inelastic scattering of energetic protons to the first (110 keV) and second (197 keV) excited states of ^{19}F is shown to be a sensitive tool for detecting trace amounts of fluorine in a large variety of environmental and biological samples. Gamma rays following inelastic excitation of fluorine nuclei are observed with a lithium-drifted germanium detector of 1.8 keV resolution. With this method the minimum detectable amount is approximately 10 ng assuming 15 minutes irradiation of the sample with a 4.8-MeV proton beam of current density 0.5 $\mu A/cm^2$. Obvious improvements in experimental parameters such as detector geometry and shielding as well as use of a low-volume, high resolution detector could improve this result by a factor of 10. Results of some investigations are presented and future applications of the method are discussed. The advantages of the technique are that minimal sample preparation is required and that very small amounts of material may be analyzed. (auth)

5957 NEW TECHNIQUES FOR THE DETERMINATION OF RESIDUAL IMPURITIES USING ELECTRON IRRADIATION. Brelot, A. (Ecole Normale Superieure, Paris). pp 413-418 of Proceedings of the Colloquium on the Characterization of Semiconductor Materials and Technologies. Lafeuille, D. (ed.). Grenoble, France; Centre d'Etudes Nucleaires (1972). (In French).

From proceedings of the colloquium on the characterization of semiconductor materials and technologies; Grenoble, France (27 Sep 1972).

The carbon, germanium, and tin impurity levels are given. The effect of high energy electron irradiation (1 to 3 MeV) on silicon samples containing carbon is recalled. The most important effect occurring is the coupling of interstitial silicon atoms produced by the irradiation with carbon atoms to form IC pairs. The wave modes associated with this pair give rise to the 921 and 931 cm^{-1} absorption lines observed. The intensity of these lines was easily determined. In this way it was possible to increase the detection limit by a factor of 10. Germanium and tin atoms, which are heavier than silicon, do not lead to easily detectable absorption lines. The concentration of Ge or Sn traces can be determined from measurements of the intensity of the 12 μ line corresponding to a vacancy-oxygen pair and a knowledge of the interaction between radioinduced vacancies with oxygen, germanium, and tin atoms. (FR)

5958 METHODS OF DETERMINING ISOTOPES OF INDUCED ACTIVITY. IV. Determination of ^{65}Zn. Rovinskii, F. Ya.; Iokhel'son, S. B.; Yushkan, E. I.; Sycheva, M. D. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 459-460(1973).

Translated from Radiokhimiya; 15: No. 3, 454-455(1973).

A method based on the ability of zinc to form soluble zincates in ammoniacal and alkaline media was developed for the radiochemical isolation of relatively small amounts of ^{65}Zn from soil samples containing fission and activation products. The activity of ^{65}Zn was calculated by means of scintillation gamma spectrometric methods. (LK)

5959 METHODS OF DETERMINING ISOTOPES OF INDUCED ACTIVITY. V. Determination of ^{113}Sn. Rovinskii, F. Ya.; Iokel'son, S. B.; Yushkan, E. I.; Sycheva, M. D. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 461-462(1973).

Translated from Radiokhimiya; 15: No. 3, 456-457(1973).

A simple method based on the precipitation of tin sulfide from hydrochloric acid was developed for the isolation of ^{113}Sn from soils containing a complex mixture of fission and induced radioactive products, with subsequent measurement of the preparations isolated on a scintillation spectrometer. Separation of ^{113}Sn from radioisotopes of antimony is carried out by the precipitation of the latter from oxalic acid solutions. (LK)

5960 METHODS OF DETERMINING ISOTOPES OF INDUCED ACTIVITY. VI. Determination of Radioisotopes of Europium. Rovinskii, F. Ya.; Iokel'son, S. B.; Yushkan, E. I.; Sycheva, M. D. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 463-465(1973).

Translated from Radiokhimiya; 15: No. 3, 457-460(1973).

A method was developed for the gamma-spectrometric determination of ^{152}Eu, ^{154}Eu, and ^{155}Eu in preparations of rare earth elements isolated radiochemically from soil samples containing a mixture of fission and activation products. (auth)

5961 CONTINUOUS MEASUREMENT OF HEAVY-ELEMENT CONCENTRATION BY GAMMA-RAY ABSORPTIOMETRY. Baumgaertel, G.; Bier, K. (Kernforschungszentrum, Karlsruhe, Ger.). CZ-Chem.-Tech.; 1: No. 9, 435-437(1972).

Absorption of ^{241}Am γ-radiation by U, Th or Pu is used to determine these metals in the g-per-liter range without interference from light elements. A device is described that allows the continuous determination of U and Pu (5 to 300 g per liter) in process liquors with a precision of ±7%. (Anal. Abstr.)

5962 EXTRACTION–SCINTILLATION METHOD OF DETERMINING RADIOISOTOPES. Gorbushina, L. V.; Zhil'tsova, L. Ya.; Matveeva, E. N.; Surganova, N. A.; Tenyaev, V. G.; Tyminskii, V. G. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 340-344 (1973).

Translated from Radiokhimiya; 15: No. 3, 336-341(1973).

Liquid scintillators have found application in analysis as a means of measuring the activity of many radioisotopes of diverse chemical forms. In a number of cases these possibilities are extended by the use of liquid scintillators based on industrial extractants (TBP) and organic solvents. Such liquid scintillators, which are quite efficient counting systems, make it possible to check a series of laborious radiochemical operations. (auth)

5963 CHOICE OF OPTICAL GEOMETRICAL CONDITIONS FOR RADIOISOTOPE X-RAY FLUORESCENCE ANALYSIS. I. Dependence of Fluorescent X-Ray Intensity on Size and Position of Source and Sample. Matsui, Y.; Furuta, T. (Government Industrial Research Inst., Nagoya, Japan). Radioisotopes (Tokyo); 22: No. 9, 485-491(Sep 1973). (In Japanese).

For the purpose of obtaining the optical geometrical conditions for radioisotope x-ray fluorescence analysis, the dependence of the characteristic x-ray intensity on the position of the source and the sample was investigated in the case of various diameters of the source and the sample. "Central source geometry" is suitable only for a small source (ϕ') and a relatively large sample diameter (ϕ) compared with the detector window diameter (ξ), i.e., $\phi' \lesssim \xi/3$ and $\phi \gtrsim 0.6\xi$. In the other cases, "Side source geometry" is suitable. In the case of a sufficiently large sample, it was confirmed that the variation of the x-ray intensity due to that of source-sample distance (D) is decreased by setting a source at a distance (Y) far from the detector in compensation for the intensity reduction. (auth)

5964 ANALYSIS OF BIOLOGICAL, CLINICAL, AND ENVIRONMENTAL SAMPLES USING PROTON-INDUCED X-RAY EMISSION. Walter, R. L. (Duke Univ., Durham, NC); Willis, R. D.; Gutknecht, W. F.; Joyce, J. M. Anal. Chem.; 46: No. 7, 843-855(Jun 1974).

A 3-MeV beam of protons of 2- to 150-nanoampere intensity has been used to excite X-ray emission from a wide range of biological and environmental samples—e.g., human tissue, body fluids, soil extracts, leaves, coal, fly ash, ion-exchange membranes, and proteins. The X-rays have been detected using a Si(Li) solid state detector for the elements P (Z = 15) through Pb (Z = 82). Linear response has been demonstrated for the typical elements of Pb, Cu, Zn, Co, and Mn from 5 ng to greater than 2 μg. A lower limit of sensitivity of approximately 200 picograms in the irradiated area has been attained with the more responsive elements when they are deposited on very thin substrates. The proton-induced X-ray emission technique seems especially suited to rapid and economical multielement analyses for samples of clinical and environmental interest. Numerous examples of data obtained are included for critical evaluation. (auth)

5965 PREPARATION AND STORAGE OF REFERENCE SOLUTIONS FOR USE IN DETERMINING THE NEUTRON FLUX IN ANALYSIS FOR FISSIONABLE ELEMENTS. Gurvich, M. Yu. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 114-126 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'noga Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

Possible sources of contamination of solutions during preparation and storage are indicated. Practical recommendations are given for making ^{235}U solutions from 10^{-5} to 10^{-13} g/g, ^{238}U from 10^{-4} to 10^{-9} g/g, and ^{232}Th from 10^{-3} to 10^{-7} g/g. A method is described for controlling the precision of the dilution and the constancy of the concentration of stored solutions. A table is given of solution concentrations used as a function of the total flux of neutrons of different energies. A practical example is shown of the use of ^{235}U solutions for determining the neutron flux in analysis of rocks for uranium. (tr-auth)

5966 COUNTING ALPHA EMITTERS BY LIQUID SCINTILLATION. Lefevre, H.; Godement, A. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Radiochem. Radioanal. Lett.; 17: No. 3, 197-205(6 May 1974). (In French).

A fast monitoring by liquid scintillation of liquid wastes, contaminated by plutonium is developed. The different scintillating mixtures and their compatibility with more or less acidic solutions, reductant or oxidant are studied. ^{241}Pu can be determined in a mixture of ^{239}Pu and ^{240}Pu. (auth)

Separation Procedures

Refer also to abstract 7467.

5967 (BARC-730) EXTRACTION OF ACTINIDES BY SOME LONG-CHAIN AMINES. Swarup, R.; Patil, S. K. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). 1974. 29p. Dep. NTIS (US Sales Only) $4.50.

The extraction behavior of Np(IV) into tricaprylmethylammonium nitrate (Aliquat-336) and of Np(V), Np(VI), Pu(VI), and U(VI) into TLA and Aliquat-336 from nitric acid medium was studied. Experiments were carried out on the extraction of these actinide ions into 10% TLA and 10% Aliquat-336 in Solvesso-100. The dependence of the extraction on (a) nitric acid concentration, (b) metal ion concentration and (c) amine concentration was studied. The Np(VI) and Pu(VI) are extracted well and to a larger extent than U(VI). The extraction of hexavalent ions increased by a factor of 2-3 when Aliquat-336 was used instead of TLA. The log-log plots between the distribution coefficient of actinide ions versus amine concentration were linear with slope unity for Aliquat-336 and about 1.3 for TLA extraction. Absorption spectra of Aliquat-336 extracts containing Np(IV), Pu(IV), Np(VI) and Pu(VI) were recorded to infer the species extracted into the organic phase. Neptunium(IV) could be quantitatively stripped from the Aliquat-336 phase by acetic, formic, perchloric, sulfuric or hydrofluoric acid. (auth)

5968 (BARC/I-135, pp 1-9) EXTRACTION OF AMERICIUM (III) AND EUROPIUM(III) FROM THIOCYANATE SOLUTION BY SOME ORGANOPHOSPHOROUS EXTRACTANTS AND ALIQUAT THIOCYANATE. Khopkar, P. K.; Narayankutty, P. (Bhabha Atomic Research Centre, Bombay). 1971.

The mechanism of synergetic extraction of americium(III) and europium(III) from 1 M ammonium thiocyanate by tri-n-octylphosphine oxide (TOPO), tri-n-butyl phosphate (TBP), and tri-n-butyl phosphine oxide (TBPO) separately and by their mixtures with aliquat thiocyanate (ASCN) is studied. In each case the distribution coefficient of metal ions is determined by keeping concentration of one component of the mixture constant and that of the other varied. The results are compared. As for the mechanism of synergetic reaction, it can be conceived as the organic phase substitution with ASCN. The mixed equilibrium constant for the reaction in the case of the organosphosphorus extractant with thiocyanate is found to increase in the order of increasing basicity of the extractant and the mixed equilibrium constant for the extractant with ASCN is found to decrease with increasing basicity of the extractants. The reasons for these findings are discussed. (INIS)

5969 (BARC/I-135, pp 9-15) SYNERGETIC EXTRACTION OF URANYL ION. Subramanian, M. S.; Pai, S. A. (Bhabha Atomic Research Centre, Bombay). 1971.

The effect of temperature on the synergetic extraction of uranyl ion with a mixture of thenoyltrifluoroacetone (TTA) with various long-chain aliphatic and aromatic sulfoxides as neutral donors was studied at temperatures of 30, 40, 50, and 60°C. The sulfoxide (DHSO), didecyl sulfoxide (DDSO), diphenyl sulfoxide (DPSO), and dibenzyl sulfoxide (DBSO). Distribution ratios of uranium concentration in the organic phase to that in the aqueous phase were calculated in each case. Thermodynamic parameters such as the Gibb's free energy (ΔF), the enthalpy (ΔH), and the entropy (ΔS) per mole were also evaluated for each system. (INIS)

5970 (ETR-271) EXTRACTION CHROMATOGRAPHY. Bibliography. Eschrich, H.; Drent, W. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Jun 1971. 131p. INIS.

About three hundred and eighty references, with abstracts on the subject title, have been compiled, covering the work on extraction chromatography (reversed-phase chromatography) until the beginning of 1971. A chronological survey (with experimentally important data) is attached in the form of a table. Complete subject and author indexes are included. (auth)

5971 (JINR-P12-7775) THERMOCHROMATOGRAPHY OF PRODUCTS OF NUCLEAR REACTIONS WITHOUT CARRIERS IN THE FORM OF CHLORIDES. Aikhler, B.; Domanov, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The deposition temperatures of chlorides of 47 elements were determined using thermochromatographic columns filled with quartz powder in a gas stream. The correlation between the adsorption temperature and the value of $\Delta H^{\circ}_{298\ subl.}$ for these compounds was found. On this basis conclusions were made about the chemical states of some elements under experimental conditions, which could not be predicted with certainty previously. By extrapolating the values of ΔH°_{298} for chlorides of elements with Z = 112-115, the probable temperature interval of their depositions is predicted. (auth)

5972 CHROMATOGRAPHIC SEPARATION OF SOME TRANSITIONAL METAL IONS IN THE PRESENCE OF ORGANIC HYDROXAMIC ACIDS. Pal, C. K.; Chakraburtty, A. K. (Jadavpur Univ., Calcutta). Separ. Sci.; 9: No. 1, 71-78(1974).

Use of organic hydroxamic acids for detection and separation of metals by circular paper chromatography was successfully applied to various metals. Salicylhydroxamic acid in the presence of isopropyl and isobutyl alcohols was found to give the best results. No developer to process the chromatograms is necessary because the metal hydroxamic acid complexes separate as distinctly colored bands. Chromatographic properties of Ti(IV), V(V), Cr(III), Mn(II), Fe(III), Co(II), Ni(II), Cu(II), and U(VI) were studied. (auth)

5973 EXTRACTION SEPARATION OF TRACER AMOUNTS OF AMERICIUM AND CURIUM BY THE OXIDATION OF AMERICIUM TO THE HEXAVALENT STATE. I. Extraction Separation with TOPO and D-2EHPA. Vdovenko, V. M.; Koval'skaya, M. P.; Smirnova, E. A. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 315-319(1973).

Translated from Radiokhimiya; 15: No. 3, 312-316(1973).

The distribution coefficients of americium(III) and americium oxidized to the hexavalent state in the starting aqueous solution were determined as a function of the composition of the aqueous solution in extraction with TOPO and HDEHP in o-xylene. From the data obtained it follows that americium(III) has much greater distribution coefficients than the oxidized form of americium. Experiments were carried out on the separation of americium and curium by oxidation of the americium to the hexavalent state and extraction with TOPO and HDEHP. The results obtained indicate that the bulk (95%) of the curium may be separated from americium by this method. (auth)

5974 SORPTION OF TETRAVALENT ELEMENTS BY MORDENITE. I. Sorption of Th(IV). Grebenshchikova, V. I.; Chernyavskaya, N. B.; Andreeva, N. R. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 311-314(1973).

Translated from Radiokhimiya; 15: No. 3, 308-311(1973).

From the example of Th it was established that tetravalent elements may be absorbed from weakly acid solutions by mordenite. It was shown that desorption is possible. The capacity of mordenite for Th was determined at 20 and 55°C. It was established that the ions Cs^+, Na^+, and Li^+ have different competing effects on the absorption of Th(IV) by mordenite and this indicates an ion-exchange mechanism for the absorption of Th at the acidities investigated. (auth)

5975 EXTRACTION SEPARATION OF TRACER AMOUNTS OF AMERICIUM AND CURIUM BY THE OXIDATION OF AMERICIUM TO THE HEXAVALENT STATE. II. Extraction Separation with 1-Phenyl-3-Methyl-4-Benzoylpyrazolone-5 (PMBP). Vdovenko, V. M.; Koval'skaya, M. P.; Smirnova, E. A. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 320-325(1973).

Translated from Radiokhimiya; 15: No. 3, 316-322(1973).

An investigation was made of the extraction of americium, curium, thulium, cerium, and europium by solutions of PMBP in various organic solvents as a function of the solution pH, the reagent concentration, and the nature of the organic solvent used. It was shown that the distribution coefficient of the elements depends strongly on the pH of the aqueous solution and the nature of the organic solvent used. The replacement of benzene by oxygen-containing solvents makes it possible to extract elements from more acid solutions. The distribution coefficients of americium oxidized to the hexavalent state in the starting aqueous solution were determined in extraction with 0.05 M PMBP in organic solvents. From the data obtained it follows that the oxidized form of americium is extracted with much smaller distribution coefficients than americium(III). Experiments were carried out on the separation of americium from bulk of curium and lanthanide elements. (auth)

5976 ADSORPTION OF AMERICIUM ON POLYTETRAFLUOROETHYLENE. Samartseva, A. G.; Zhuravleva, Z. A. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 307-310(1973).

Translated from Radiokhimiya; 15: No. 3, 304-308(1973).

A study was made of the adsorption of americium on polytetrafluoroethylene (PTFE) from nitric acid solutions in relation to the concentration of hydrogen ions from 10^{-1} to 10^{-12} M. It was established that up to pH ~3 the adsorption of americium on PTFE is insignificant (2–3%), while at pH 3.5–4.5 a sharp rise to 85% is observed on the adsorption curve with the formation of a broad maximum up to pH 7.0. A study was made of the desorption of americium from PTFE by inactive solutions with the same pH values as the solutions from which its adsorption was studied. It was established that in solutions up to pH 5.0 the adsorption of americium on PTFE is reversible. Consequently, over this range of pH values there is ionic and not molecular adsorption of americium on PTFE. It was found that the curve for the adsorption of americium on PTFE as a function of pH agrees very closely with the analogous adsorption curve for americium on platinum. On the basis of the data obtained it is concluded that the mechanisms of the adsorption of americium on a polished platinum surface and PTFE are analogous. (auth)

5977 SEPARATION OF RADIOACTIVE Cs ISOTOPES USING AMMONIUM TETRARHODANODIAMINE CHROMATE. Bagbanly, I. L.; Shirai, M. V.; Rustamov, N. Kh. Azerb. Khim. Zh.; No. 4, 133-137(1973). (In Russian).

A rapid method was developed for determining the radioactive isotopes of Cs. It was established that radioactive Cs is recovered quantitatively (at least 99.0%) and selectively from a complex isotope mixture. The time required for an analysis is 15–20 min. (tr-auth)

5978 EXTRACTION TETRAVALENT ACTINIDES AND URANIUM(IV) FROM NITRIC ACID SOLUTIONS BY SOLUTIONS OF TRI-N-OCTYLAMINE IN N-OCTYL ALCOHOL. Shesterikov, V. N.; Shmidt, V. S. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 326-331(1973).

Translated from Radiokhimiya; 15: No. 3, 322-327(1973).

An investigation was made of the relation of the distribution coefficients of plutonium(IV), neptunium(IV), thorium(IV), and uranium(VI) between nitric acid solutions and solutions of tri-n-octylammonium nitrate in a mixture of octyl alcohol and dodecane to the concentration of nitric acid in the aqueous phase and that of the amine in the organic phase. From the example of these systems the previously established rule that the use of electrophilic diluents that solvate the nucleophilic functional groups of extractant molecules leads to a shift in the extraction maximum to higher concentrations of the acids, including the basic anion-ligand of the system was confirmed. The distribution coefficients may be calculated using a mathematical model based on the law of mass action taking into account the nonideality of the organic phase, by means of Solovkin's empirical equation. In the systems investigated satisfactory agreement was obtained between the experimental and calculated values of the distribution coefficient of plutonium(IV) over a wide range of acid and extractant concentrations. (auth)

5979 INFLUENCE OF CROSS-LINKAGE OF ANION EXCHANGERS ON THE DISTRIBUTION COEFFICIENT OF SAMARIUM IN MIXED SYSTEMS OF ORGANIC SOLVENT AND MINERAL ACID. Spiridon, S.; Grigorescu-Sabau, C. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Chim.; 19: No. 1, 131-139 (Jan 1974).

Distribution coefficients were determined for Sm^{3+} ions between mixed solutions of alcohol and nitric acid and Dowex-1 resin with various cross-linkage degrees. With the aid of these values and the specific volumes determined by the pycnometric method, the charge of the complex ions formed in these solutions was calculated. (auth)

5980 SYNERGISM IN THE SOLVENT EXTRACTION OF TETRAVALENT METAL IONS. A Study of the Formation of the Synergistic Adducts. Bok, L. D. C.; Wessels, G. F. S.; Leipoldt, J. G. (Univ. of the Orange Free State, Bloemfontein, South Afr.). Z. Anorg. Allg. Chem.; 404: No. 1, 76-80(Mar 1974).

Complexes of the type $M(LL)_4$, where M = Zr(IV), Hf(IV), Th(IV) and U(IV), and LL = β-diketone with different acid strengths (viz., acetylacetone, dibenzoylmethane, thenoyltrifluoroacetone, trifluoroacetylacetone and hexafluoroacetylacetone) were used to prepare adducts of the type $M(LL)_4 \cdot S$, where S represents the neutral phosphorus esters with various basicities (viz., tributylphosphate, trioctylphosphine oxide, triphenylphosphine oxide and triphenylphosphate). It was found that no adducts of the Zr(IV), Hf(IV) and U(IV) complexes were formed. Adducts of the Th(IV) complexes were formed only if the β-diketones were relatively strong acids (e.g., thenoyltrifluoroacetone, trifluoroacetylacetone and hexafluoroacetylacetone). Results of the attempted preparations showed that the possibility of adduct formation between β-diketone complexes and phosphorus esters is influenced by the acid strength of the β-diketone, the basicity of the phosphorus ester, the ionic radii, and the electron configuration of the metal. (auth)

5981 SOLUBILITY OF CERIUM AND PRASEODYMIUM 8-HYDROXYQUINOLINATES IN ORGANIC SOLVENTS. Kopunec, R. (Komenskeho Univ., Bratislava); Kotocova, A. Chem. Zvesti; 28: No. 1, 77-82(1974).

The solubility of $CeOx_4$ and $PrOx_3$ in nine solvents at 25°C was determined. The solubility of $CeOx_4$ varies in the range $1.54 \times 10^{-3} - 0.03 \times 10^{-3}$ kmol m^{-3} and decreases in the following order: chloroform > tetrahydrofuran > dioxane > benzene > chlorobenzene > carbon tetrachloride > acetone > acetonitrile > carbon disulfide. For $PrOx_3$ the solubility is $8.4 \times 10^{-5} - 1.0 \times 10^{-5}$ kmol m^{-3} and decreases in the order: chloroform > benzene > tetrahydrofuran > chlorobenzene > carbon tetrachloride > acetone > dioxane > carbon disulfide > acetonitrile. From the determined solubilities in the water-immiscible solvents and from the known solubility products, the two-phase stability constants and the extraction constants of the studied chelates were calculated. (auth)

5982 THERMODYNAMICS OF LIQUID–LIQUID DISTRIBUTION REACTIONS. 4. The Synergistic Extraction of Uranium(VI) With Di-2-ethylhexyl Phosphoric Acid and Tri-n-butyl Phosphate. Marcus, Y.; Kolarik, Z. (Kernforschungszentrum, Karlsruhe, Ger.). Inorg. Nucl. Chem. Lett.; 10: No. 4, 275-282 (Apr 1974).

Calorimetric determinations were made of the heat evolved on the synergistic extraction of uranium (VI) with di-2-ethylhexyl phosphoric acid (HDEHP) and tri-n-butyl phosphate (TBP) in dodecane. The results show that the addition of TBP to a given concentration of HDEHP leads to an appreciable heat effect, increasing with the concentration of the TBP. The main effect is shown in the region of one or two moles of TBP per mole HDEHP. The effect of loading the extractant with uranium is much more marked than for the extraction with HDEHP alone. The large negative enthalpy change for the extraction reaction observed by Sato [J. Inorg. Nucl. Chem.; 26:311 (1964)] in temperature coefficient measurements was confirmed calorimetrically. (UK)

5983 TECHNIQUES FOR THE MUTUAL SEPARATION OF THE LANTHANIDES IN ANALYTICAL CHEMISTRY. Das, H. A.; van Ooyen, J. (Reactor Centrum, Petten, Netherlands). pp 25-38 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

Three techniques for mutual separation of rare earths are discussed: ion exchange, reversed phase extraction chromatography, and high-voltage electrophoresis. (LK)

5984 DETERMINATION OF RARE-EARTH IMPURITIES IN PURE RARE EARTHS BY MEANS OF EXTRACTION CHROMATOGRAPHY. Hermann, E. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 39-53 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

Determination of rare-earth impurities in very pure rare earth materials is frequently difficult without a preconcentration of the tracers. We have investigated the use of extraction chromatography with undiluted di(2-ethylhexyl) phosphoric acid (HDEHP) as a stationary phase for the concentration of tracers with lower atomic number relative to that of the macro element. Enrichment factors of about 10^6 and yields of more than 80% were obtained with excellent reproducibility when $A_{macro}/D_{micro} \geq 1.5$. D_{micro} is the partition coefficient of the trace impurity, A_{macro} is the position of the front, normalized to the unit HDEHP-volume on the column, and depends on the loading B (expressed in %) of the column with rare earth ions and on the partition coefficient E of the macro element measured in trace concentration. This dependence can be expressed by the empirical equation: $\lg A = \lg E - 0.036B - 0.15$. The influence of macro amounts of a given rare-earth element on the partition behavior of other lanthanides present in trace concentration has also been investigated. The amount of an individual rare earth in the concentrate was determined by one of the following methods: optical spectrometry, neutron activation analysis, spectrophotometry with arsenazo III, or complexometric titration with DTPA. In the last two cases, it is necessary to use a preliminary separation of the components in the concentrate. This was done either by the cation exchange α-hydroxy-isobutyrate method or by means of extraction chromatography using a HDEHP microcolumn. The standard deviation of the determinations depends only on the analytical procedure, the preconcentration being of negligible importance in this respect. (auth)

5985 ANION EXCHANGE CONCENTRATION OF RARE-EARTH IMPURITIES IN RARE-EARTH MATERIALS FOR ANALYTICAL PURPOSES. Molnar, F. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 55-59 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

For a total analysis of rare-earth impurities in very pure rare-earth matrix elements it is necessary to concentrate these impurities before their analysis. For this purpose an anion exchange method, based on the chromatographic separation of the impurities and the matrix element using aqueous methanol solutions of ammonium nitrate as eluents, was developed. It was stated that from the cerium subgroup matrices all rare-earth impurities, except the heavier adjacent one, from the yttrium subgroup matrices only cerium subgroup impurities, and (depending on the atomic number of the matrix element) terbium and dysprosium, can be separated. The enrichment factor for this concentration procedure is about 10^3. The concentrated impurities can be processed further as required by the method chosen for their analytical determination. (auth)

5986 USE OF AQUEOUS ALCOHOL SOLUTIONS OF NITRIC ACID TO ISOLATE AND SEPARATE TRANSPLUTONIUM ELEMENTS. Guseva, L. I.; Tikhomirova, G. S.; Grigor'eva, S. I. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 397-401(1973).

Translated from Radiokhimiya; 15: No. 3, 397-401(1973).

An investigation was made of the effect of different factors (HNO_3 and CH_3OH concentrations in the solution, DVB content of the resin, and degree of loading of the resin with the macrocomponent) on the sorption and separation of some transplutonium and rare earth elements on anionites by means of aqueous alcohol solutions of nitric acid. The distribution coefficients of the elements investigated increased with an increase in the acid and alcohol concentrations in the solution and the DVB content of the resin. Separation of americium and curium is best on anionites with a low content of DVB (~4%) using 0.5-0.75 M HNO_3 in 80% CH_3OH, while they are best concentrated on resins with a high DVB content (~8%) from solutions with an HNO_3 concentration ≥0.5 M containing ≥90% alcohol. The separation of transcurium elements is unsatisfactory under these conditions. The distribution coefficients of curium decrease and the separation of Am and Cm deteriorates with an increase in the loading of the resin with the macrocomponent. Good separation is achieved when the loading of the resin is ≤2% of the total capacity of the anionite. Cerium and plutonium may be separated from transplutonium elements with simultaneous separation of the latter from each other on anionites by means of aqueous alcohol solutions of HNO_3. (auth)

5987 SORPTION OF CERIUM(III) AND YTTRIUM BY A MIXTURE OF CATIONITE KU-2 AND LEAD SULFATE. Afanas'ev, Yu. A.; Ryabinin, A. I.; Karuna, A. G. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 436-438(1973).

Translated from Radiokhimiya; 15: No. 3, 435-437(1973).

A study was made of the sorption characteristics of a mixed sorbent (KU-2 + lead sulfate) with respect to cerium(III) and yttrium nitrates. The conditions for desorption of rare earth elements in this system were determined. The selectivity of the sorption properties of lead sulfate toward light and heavy rare earth elements was established. (auth)

5988 SORPTION OF URANIUM FROM BLACK SEA WATER BY ANIONITES. Ryabinin, A. I.; Lazareva, E. A.; Doroshenko, G. A. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 439-441(1973).

Translated from Radiokhimiya; 15: No. 3, 437-440(1973).

Practical and calculated data from an investigation of the sorption of uranium from Black Sea water under dynamic conditions by 15 Soviet anionites are given. (LK)

5989 CONCENTRATION AND SEPARATION OF TRANSPLUTONIUM ELEMENTS FROM A SERIES OF FISSION AND OTHER ELEMENTS ON ANIONITES FROM HNO_3-CH_3OH SOLUTIONS. Guseva, L. I.; Tikhomirova, G. S. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 402-404(1973).

Translated from Radiokhimiya; 15: No. 3, 401-404(1973).

The distribution coefficients of transplutonium elements, Pu, fission elements (Cs, Sr, Zr-Nb, Ru, Eu, Ce), and also Fe were determined under conditions under which it is possible to concentrate transplutonium elements on anionites. There was considerable sorption of transplutonium elements from pure solutions of CH_3OH and an increase in the sorption of the transplutonium elements from alcohol solutions of HNO_3 in the presence of aluminum nitrate. A method was developed for the separation of transplutonium elements from a series of fission elements (Cs, Sr, Zr-Nb, Ru) and macroimpurities (Al and Fe) by their concentration on an anionite with subsequent separation from each other and also from cerium and plutonium on one column. (auth)

5990 SOLVENT EXTRACTION BEHAVIOR OF SOME METALS IN TBP SOLVENT SYSTEM. Yoshizawa, S.; Shimotori, S. (Kyoto Coll. of Pharmacy). Tech. Rep. Inst. At. Energy, Kyoto Univ.; No. 159, 1-5(Mar 1973).

The addition of ammonium thiocyanate solution to the system of TBP-kerosene solvent increases the distribution coefficient of thorium. The separation of thorium from some metals, such as cerium(IV), lanthanum, yttrium and zirconium was carried out by the above solvent extraction procedure. Separation of thorium from zirconium is almost impossible by this procedure, but the other metals separate from thorium under these particular conditions. (auth)

5991 EXTRACTION OF Mo(VI) FROM CONCENTRATED SULFURIC ACID SOLUTIONS BY TRI-N-BUTYL PHOSPHATE. Kopach, S. (Univ., Wroclaw). Zh. Neorg. Khim.; 19: No. 3, 794-799(Mar 1974). (In Russian).

The extraction of Mo(VI) by TBP from concentrated sulfuric acid solutions was studied as a function of the Mo and acid concentrations in the aqueous phase. The effect of the metal concentration was determined, and the effect of polymerization in the organic phase on the extraction process was observed. Spectroscopic studies were carried out to determine the extraction mechanism. Equations are given for Mo(VI) extraction from sulfuric acid solutions. (tr-auth)

5992 CHEMISTRY OF PROTACTINIUM. X. Effect of Chromium(II) on the Solvent Extraction of Protactinium(IV), Using N-Benzoyl-N-Phenylhydroxylamine, Tri-N-Octylamine and Thenoyltrifluoroacetone as the Extractants. Kawasuji, I.; Suzuki, S. (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap.; 47: No. 1, 104-108(Jan 1974).

Cr(II) has been used for reducing protactinium in microquantities to the tetravalent state and for protecting it from reoxidation. However, the effect of Cr(II) on the extraction behavior of Pa(IV) has not been taken into account by all of the previous investigators. On the basis of the above facts, the influence of Cr(II) on the extraction of Pa(IV) was studied by using such extractants as BPH, TTA, and TOA. In every case, the distribution ratio of Pa(IV) decreased with an increase in the concentration of Cr(II) in the aqueous phase. One of the most reliable explanations for the phenomena is the possibility that a multi-nuclear complex between Pa(IV) and Cr(II) or Cr(III) is formed. However, the effect of Cr(II) on the absorption spectra of Pa(IV) could not be found, and many more experiments will be necessary to explain the effect of Cr(II) on the extraction behavior of Pa(IV). (auth)

5993 SOLVENT EXTRACTION OF CESIUM ION WITH SOME PHENOL DERIVATIVES. Tochiyama, O. (Tohoku Univ., Sendai). Technol. Rep. Tohoku Univ.; 38: No. 2, 419-451(Feb 1973).

The liquid-liquid extraction of cesium ion was studied by using o-, m-, p-nitrophenols, a-dinitrophenol, picric acid, p-cresol and p-tert-octylphenol as the extracting reagents. Ionic equilibria taking place in the systems were studied by means of conductivity and solubility measurements in connection with the extraction study. It was concluded that: (1) all the cesium phenolates extracted into nitrobenzene are mainly in the dissociated form; (2) the extraction of phenolates proceeds by the stepwise adduct formation with free phenols. However, ortho-substituted phenolates show little tendency to adduct formation; (3) among the phenols investigated, p-tert-octylphenol is the only reagent which can considerably extract cesium ion into some non-polar solvents, such as n-hexane, carbon tetrachloride and benzene. In these solvents, cesium p-tert-octylphenolate is in the associated form adducted with three p-tert-octylphenols. (auth)

5994 EXTRACTION OF TRIS-(1,10-PHENANTHROLINE)-RUTHENIUM(II). I. Distribution Studies. Takamatsu, T. (Kyoto Univ.). Bull. Chem. Soc. Jap.; 47: No. 1, 118-126(Jan 1974).

Tris(1,10-phenanthroline)Ru(II) was extracted into various organic solvents with several anions, such as the perchlorate ion, the iodide ion, or the thiocyanate ion. The association constants of ion-pairs were successfully determined by analysis of the extraction curves in the solvents with low polarities. It was found that the ion-pairs were extracted mainly as the associated form and that only the first-step dissociation could slightly occur ($<10^{-1}$) in such solvents; furthermore, the degree of association was considerable even in water. Therefore, the distribution ratio of the complex cation must be governed by both the hydration energy of the counter anion and the solubility parameter of the extraction solvent rather than its dielectric property. An abnormal decrease in the distribution ratio was observed when the tetraphenylborate ion was used as the counter anion. This phenomenon can be explained clearly in terms of the hydrotropism which was often encountered in the solution of an electrolyte with a large ion. (auth)

5995 MECHANISM OF THE EXCHANGE OF LANTHANIDE IONS BETWEEN A CATION-EXCHANGE RESIN AND A SOLUTION

OF ETHYLENEDIAMINETETRA-ACETATE. Martynenko, L. I.; Yashkarova, M. G. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 8, 1175-1177(Aug 1973).

Translated from Zh. Fiz. Khim.; 47: No. 8, 2089-2090(Aug 1973).

In dilute solutions of ethylenediaminetetra-acetate, noncomplexed praseodymium and neodymium ions are transferred between the phases, while in concentrated solutions the species transferred are neutral ethylenediaminetetra-acetates Ln_1A_3. The latter exchange mechanism predominates in the practical preparation of macroamounts of pure lanthanides. (auth)

5996 EXTRACTION OF URANIUM(VI) AND THORIUM(IV) FROM NITRIC ACID SOLUTIONS BY TRI-n-OCTYL PHOSPHINE OXIDE. Sato, T.; Nishida, T.; Yamatake, M. (Shizuoka Univ., Hamamatsu, Japan). J. Appl. Chem. Biotechnol.; 23: No. 12, 909-917(Dec 1973).

The distribution of uranium(VI) and thorium(IV) between nitric acid solutions and solutions of tri-n-octyl phosphine oxide (TOPO) in kerosene has been investigated. The organic phases have been studied by infrared and nuclear magnetic resonance spectroscopy. Further, the absorption spectra of both the aqueous and organic phases have been examined in the extraction of uranium(VI). (auth)

5997 EXTRACTION OF SELENIUM(IV) AND TELLURIUM(IV) FROM HYDROCHLORIC ACID SOLUTIONS AND SOME BENZAZOLES. Doicheva, R.; Angelova, V. (Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 10, 1359-1362 (1972).

Solutions (up to 0.1M) of benzoxazolone, benzothiazolone, 2-mercaptobenzoxazole (I) and 2-mercaptobenzothiazole (II) in $CHCl_3$ were tested as extractants for Se(IV) and Te(IV) from 0.01 solution in dilute HCl. No satisfactory procedure for extraction of Te(IV) was discovered, but Se(IV) could be extracted from 7.7M HCl by 0.01M-I or -II. (Anal. Abstr.)

5998 CHROMATOGRAPHIC SEPARATION OF METAL IONS ON LOW CAPACITY, MACRORETICULAR RESINS. Fritz, J. S.; Story, J. N. (Ames Lab., IA). Anal. Chem.; 46: No. 7, 825-829 (Jun 1974).

Forced-flow chromatography on partially sulfonated, macroreticular resin beads is used to obtain several rapid metal ion separations. Separations of thorium(IV) from lanthanum(III); thorium(IV) from zirconium(IV); calcium(II) from magnesium(II); zinc(II), lead(II); copper(II), maganese(II), and nickel(II) from each other, and a separation of lead(II) from large amounts of other divalent ions are demonstrated. Low-capacity resins provide rapid separations in strongly acidic eluents of moderate concentrations. In-stream addition of color-forming reagent provides continuous detection and accurate quantitation of eluted metals. (auth)

5999 LIQUID–LIQUID EXTRACTION OF SEVERAL ELEMENTS IN THE SYSTEM OF FUSED $Ca(NO_3)_2 \cdot 4H_2O$ AND TRI-N-BUTYL PHOSPHATE. Aratono, Y.; Akatsu, E. (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 36: No. 5, 1141-1146(May 1974).

The liquid–liquid extraction of several elements of actinides and fission products was radiochemically studied in the system of fused calcium nitrate tetrahydrate and tri-n-butyl phosphate in n-paraffin diluent at 45°C. The solvation number of several elements in the organic phase was graphically determined by the dilution ratios. The solvates were similar to those in the aqueous nitrate and the anhydrous nitrates eutectic-tri-n-butyl phosphate systems. (auth)

6000 RADIOMETRIC STUDIES OF THE EXTRACTION OF METAL IONS. XVI. Extraction of Zn(II), Hg(II), Fe(III), Co(II), and Ni(II) Chelates with α-mono-anil of β-phenyl α,β-diketothiopropionic Acid Anilide. Mirek, J. (Jagiellonian Univ., Krakow); Moskal, J.; Stronski, I. Radiochem. Radioanal. Lett.; 17: No. 3, 139-144(6 May 1974).

^{59}Fe, ^{60}Co, ^{63}Ni, ^{65}Zn and ^{203}Hg isotopes were used to investigate the extraction of metal chelates with α-mono-anil of β-phenyl α,β-diketothiopropionic acid anilide (ATPA). The distribution ratio D of Zn(II), Hg(II), Fe(III), Co(II), and Ni(II) ions between water and chloroform were determined at different pH values and the pH_{50} values were calculated. It was found that the lanthanide–alkali metal and uranyl ions are not extracted under the experimental conditions studied. (auth)

6001 COPRECIPITATION BEHAVIOR OF RADIORUTHENIUM IN SEA WATER. I. Imai, K.; Watari, K.; Izawa, M. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 4, 369-374(Dec 1973).

The coprecipitation behavior of ruthenium in sea water with ferric hydroxide and cobalt sulfide was studied. It was found that the coprecipitation yield was considerably affected by chemical forms of ruthenium (chloro, nitrosyl nitrato and nitrosyl nitro complexes). With ferric hydroxide formed at pH 9 by adding sodium hydroxide or ammonia water, chloro complex was coprecipitated quantitatively, while nitrosyl nitrato and nitrosyl nitro complexes were coprecipitated as few as about 50 and 10%, respectively. When cobalt sulfide was formed at pH 9 by adding thioacetamide, all the three species were coprecipitated quantitatively. In the case of using ammonium sulfide as the reactant instead of thioacetamide, the coprecipitation yield for chloro complex was quantitative, but those for nitrosyl nitrato and nitro complexes were considerably reduced. The yields for the latter two species were increased with elapsed time after the addition of radioruthenium to sea water. (auth)

6002 ANION EXCHANGE BEHAVIOR OF MOLYBDENUM IN THE PRESENCE OF PHOSPHORIC ACID. Padmanabhan, P. K.; Venkateswarlu, Ch. (Bhabha Atomic Research Centre, Bombay). Compt. Rend. Acad. Bulg. Sci.; 27: No. 2, 223-225(1974).

The anion exchange behavior of molybdenum in phosphoric acid solutions was studied using ^{99}Mo as a tracer. The distribution ratio of molybdenum was determined by equilibrating 1.0 g of Amberlite IRA-400 with 30 ml aqueous solution of the required composition with respect to molybdenum, phosphoric acid, and other mineral acids. The molybdenum (^{99}Mo) in the aqueous phase was estimated radiometrically. (LK)

6003 ION EXCHANGE KINETICS OF MOLYBDENUM(VI) ON ANIONITES. Vassilev, H.; Petkova, E. N. (Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 2, 211-214 (1974).

Neutral solutions containing only monomer forms of molybdenum(VI) (MoO_4^{2-}) and solution containing only polymer forms (on the basis of $Mo_3O_{10}^{2-}$) with a pH 2.5 were investigated. The experiments were made in dynamic and static conditions in order to determine the kinetics during the molybdenum absorption of these ion-exchange resins. (LK)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 7296 and 7958.

Chemical and Physicochemical Properties

Refer also to abstracts 7255 and 7430.

6004 (ORO-3518-45) ELECTROCHEMICAL STUDIES IN MOLTEN FLUORIDES AND OTHER HALIDES. Final Report. Mamantov, G. (Syracuse Univ., N. Y. (USA). Dept. of Physics). Apr 1974. Contract AT(40-1)-3518. 18p. Dep. NTIS $4.00.

This research program was primarily concerned with electrochemical and spectroscopic (Raman, UV-visible) studies of solute species in molten fluorides and chloroaluminates ($AlCl_3$-NaCl mixtures). The fluorides are important in several technological applications, including the Molten Salt Reactor program and production of aluminum and fluorine. The chloroaluminates are used in a new pilot plant process for the production of aluminum. These media are known to stabilize unusually low oxidation states. The accomplishments of this program include: (1) Using a Ni(II)/Ni reference electrode, developed in this program, EMF series for two important fluoride melts were experimentally determined and the electrochemistry of several solute species was investigated. This work was accompanied by some spectroscopic measurements of solute species in fluoride melts. (2) Chloroaluminate melts were characterized by EMF measurements and Raman spectroscopy at different compositions and temperatures. Raman spectra of other acidic melts containing $AlCl_3$ were obtained. (3) The redox chemistry of several elements was studied electrochemically in molten chloroaluminates. A new subvalent species of mercury, Hg_3^{2+}, was completely characterized. (auth)

6005 (TRG-REPORT-2458) SOLUBILITIES OF SODIUM BROMIDE AND SODIUM IODIDE IN SODIUM. Allan, C. G. (UKAEA Reactor Group, Dounreay. Dounreay Experimental Reactor Establishment). Nov 1973. 27p. Dep. NTIS (US Sales Only) $4.50.

The solubilities of sodium bromide and sodium iodide in reactor grade sodium at 150–450°C are reported. The halides dissolve as the dissociated ions, solvated by the liquid metal, and the solutions show large deviations from the ideal and small deviations from regularity. This is interpreted in terms of short-range order in the solution. Fission product halides will collect in the cooler parts of fast reactor circuits, especially filtration cold traps, and the radiation levels from these components will be high. The addition of stable halide followed by cold trapping may be an efficient method of removing halide activity from fast reactor primary circuits. (auth)

6006 METAL COMPLEXES OF 2-GUANIDINOBENZIMIDAZOLE. Hussain, M. S.; Ali, T.; Ali, S. M. (Univ. of Peshawar, Pakistan). Pak. J. Sci. Ind. Res.; 16: No. 3-4, 96-99(1973).

GBM forms complexes not only with the first row transition metals, but it also coordinates with metals such as Au(I), Pt(IV), Th(IV), and Cd(II). Some of these metals form only mono complexes whereas bis- and tris-complexes are formed with other metals. The physical measurements on these complexes indicate that in bis-complexes two GBM molecules coordinate with the central metal atom in the xy-plane and the anions occupy the apical z-positions, resulting in a distorted octahedral configuration around the metal atom. (auth)

6007 ELECTROPHORESIS OF TRACE QUANTITIES OF YTTRIUM. Polansky, P. (Military Academy, Brno); Bar, J. Collect. Czech. Chem. Commun.; 39: No. 4, 1025-1028(Apr 1974).

Electrophoresis of aqueous solutions of ^{91}Y in trace concentrations (about 10^{-11} to 10^{-13}M) was studied over the pH range 1.6 to 11.6, and at 25°C, using unscreened electrodes and electrodes screened by a cellophane membrane. It was found that the portion of positively charged forms of ^{91}Y in all (positively and negatively) charged forms of this nuclide exhibited an over-all decrease with increasing pH from very high values in the strongly acid region to very low values in the alkaline region. This dependence showed a deep minimum at pH 3 to 4 and a maximum at pH 4 to 5. The portion of cationic forms of ^{91}Y in all charged forms of this nuclide decreased with increasing pH from very high values in strongly acid solutions to a minimum at pH 4 to 5; over the region pH 5.6 to 10.4 it was approximately constant and close to 50%. A sudden increase of the portion of negatively charged forms of ^{91}Y with increasing pH, accompanied by a simultaneous abrupt decrease of anions in solutions of pH > 10.4 is undoubtedly connected with the formation of a negatively charged colloid of yttrium hydroxide. (auth)

6008 MOLYBDENUM(VI) BEHAVIOR DURING ANION EXCHANGE IN HYDROCHLORIC ACID MEDIUM. Vassilev, H.; Petkova, E. N. (Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 1, 51-54(1974).

During anion exchange of molybdenum in hydrochloric acid medium compounds of great complexity are formed, depending on the concentration of molybdenum and the acidity of the medium. With an increase of the hydrogen ion concentration the number of molybdenum atoms participating in a gram-equivalent also increases. The following quantitative expression was found for this dependence: $K_{mg} = 355 + 0.636C_{Mo} + 37pN - 0.087C_{Mo}pH - 11.8pH^2$, where K_{mg} denotes the capacity of 1 g of ionite expressed in μg and C_{Mo} is the molybdenum concentration in mg. (LK)

6009 ANALYSIS AND APPLICATION OF RARE EARTH MATERIALS. NATO Advanced Study Institute, Kjeller, Norway, August 23–29, 1972. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973). 382p. (CONF-720839-). $34.00.

Twenty-three papers were presented at the conference, and separate abstracts were prepared for 12 papers. Nine papers were previously abstracted for NSA and appeared as abstracts 28:05135, 28:29589, 28:30418, 28:30419, 28:30506, 28:30507, 28:30508, 28:30537, and 28:30582. (LK)

For abstracts of individual papers see: 5864, 5925–5927, 5949, 5950, 5983–5985, 6010, 6011, and 6428.

6010 GENERAL REVIEW OF SCIENTIFIC AND TECHNOLOGICAL ASPECTS OF THE UTILIZATION OF RE MATERIALS. Gschneidner, K. A. Jr. (Ames Lab., IA). pp 1-7 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

The major uses and some of the more promising potential applications are examined from a scientific and technological view. This has led to the subdivision of these applications into four groups: those uses based on (1) the similar chemical nature of the rare earths, (2) the 4f electrons, (3) valence states different than +3, and (4) nuclear properties. In general, the mixed rare earths are used primarily in (1) and the separated individual elements in (2), (3), and (4), although some notable exceptions are found. The scientific basis for the various applications is briefly discussed. (auth)

6011 FUNDAMENTAL PROPERTIES OF RE ELEMENTS AND THEIR IMPLICATIONS ON THE ANALYTICAL CHEMISTRY OF RE MATERIALS. Gschneider, K. A. Jr. (Ames Lab., IA). pp 9-24 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

The electronic configurations of the metallic state, the ground state (gaseous atoms), and the trivalent ions of the rare-earth elements are given. The relationship between these configurations and the chemical and physical properties of the metals and some of the important compounds is discussed. A separate section is devoted to the spectra of the rare-earth elements. Some comments are made regarding the influence some of these properties have on various analytical techniques. (auth)

6012 STUDY OF SOME METHODOLOGICAL CHARACTERISTICS OF THE RADIOCHEMICAL DETERMINATION OF SOLUBILITY, ON THE EXAMPLE OF THE DETERMINATION OF THE SOLUBILITY OF TRIVALENT CERIUM OXALATE. Berdonosov, S. S. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 405-410(1973).

Translated from Radiokhimiya; 15: No. 3, 405-410(1973).

With accurate allowance for adsorption and colloid formation the radiochemical method of determining solubility makes it possible to obtain results that agree with the results of other methods. The specific activity of the samples used does not have an effect on the solubility values determined. In carrying out experiments to determine solubility particular attention must be paid to the completeness of separation of suspended and colloidal particles from the solution analyzed. In carrying out experiments to determine solubility, it is desirable to use samples which have not been stored for long after their synthesis. (auth)

6013 STATE OF SILICIC ACID IN NITRIC ACID SOLUTIONS. Ginzburg, F. L.; Sheidina, L. D. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 410-415(1973).

Translated from Radiokhimiya; 15: No. 3, 410-415(1973).

A systematic study of the state of silicic acid in weakly acid and weakly alkaline solutions and also strongly acid nitric acid solutions with different SiO_2 contents showed that there is a complex relation of the ratio of the monomeric and polymeric forms of the acid to the composition of the solution and its "age." An investigation of the kinetics of the polymerization of silicic acid made it possible to define the factors which affect its state and particularly the important role of its own concentration. It was shown that in the study of the state of radioelements in solution it is necessary to take into account the possible presence of silicic acid and also to analyze solutions of the same age. (auth)

6014 RADIOMETRIC DETERMINATION OF SORPTION WITHOUT SEPARATION OF PHASES. Melikhov, I. V.; Rudin, V. N.; Komarov, V. F. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 432-435(1973).

Translated from Radiokhimiya; 15: No. 3, 432-434(1973).

A basis is provided for studying sorption without separation of the sorbent from the solution. A study was made of the sorption of potassium sulfate over the range of concentrations of 10^{-4}–10^{-3} M by $BaSO_4$ crystals. It was shown that the results of determining the shape of the sorption isotherm without separation and with separation of the phases agree well. (auth)

6015 RADIOCHEMICAL STUDIES OF FREE RADICAL VINYL POLYMERIZATION. V. Polymerization of Methacrylonitrile in Dimethylsulphoxide Solution. Ayrey, G.; Mead, B. C.; Wong, D. J. D. (Queen Elizabeth Coll., London). Eur. Polym. J.; 10: No. 1, 85-89(Jan 1974).

[^{14}C]-Azoisobutyronitrile was used to initiate free radical polymerization of methacrylonitrile at 60° in dimethylsulfoxide solution. Approximately two initiator fragments were found combined with each polymer molecule, indicating that termination was almost exclusively by combination of pairs of polymer radicals. (auth)

6016 INVESTIGATIONS ON THE EQUILIBRIA OF INDIUM(III) ACETATO COMPLEXES IN AQUEOUS SOLUTIONS USING RADIOACTIVE INDIUM AND LIQUID ION EXCHANGE. Lasztity, S. (Lorand Eoetvoes Univ., Budapest). Radiochem. Lett.; 17: No. 3, 189-195(6 May 1974).

Stability constants of 1:1 and 1:2 indium(III) acetato complexes have been determined at different ionic strengths, by means of a liquid ion exchanger (di-2-ethylhexylphosphoric acid) and $^{114-114m}$In isotope labelling. The stability constants at constant ionic strength but at different pH above pH = 1 have been found to depend on pH, indicating the existence of In(III) hydroxo and mixed In(III) acetato-hydroxo complexes in addition to In(III) acetato complexes. (auth)

Isotope Effects

Refer also to abstracts 6086, 6093, 6110, 6115, and 6155.

6017 REDUCTION OF THE CURIE TEMPERATURE IN DEUTERATED DICALCIUM STRONTIUM PROPIONATE. Bolsun, A. I.; Varikash, V. M.; Zarembovskaya, T. A. (Minsk Radiotechnical Inst., USSR). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 121-122(1974). (In Russian).

It was shown that a reduction of the Curie temperature in

deuterated dicalcium strontium propionate can be explained under the assumption that the phase transition mechanism in this crystal is connected with the ordering of the C_2H_5 group as a result of its delayed rotation. (tr-auth)

6018 REACTIONS OF ACTIVE NITROGEN WITH SIMPLE ALCOHOLS. Roscoe, J. M.; Roscoe, S. G. (Acadia Univ., Wolfville, Nova Scotia). Can. J. Chem.; 51: No. 22, 3671-3679 (15 Nov 1973).

The reactions of active nitrogen with CH_3OH, C_2H_5OH, n-C_3H_7OH and iso-C_3H_7OH were studied as a function of temperature. The rate constants for these reactions are given. Experiments with CH_3OH, CH_3OD, and CD_3OD indicate a small primary isotope effect for OH and a secondary isotope effect for CH. This, with other data, implies that abstraction of a H atom from the alcohol is not an important initial step. Consumption of N atoms ranged from 4.7 to 7.1 times the alcohol consumed. With the exception of the reaction of active nitrogen with iso-C_3H_7OH, the only detectable stable reaction product was HCN. Intervention of O atoms as intermediates appears to be important in all the reactions. In the reaction of active nitrogen with iso-C_3H_7OH, acetone and acetonitrile were also found as products in amounts of about 26% and 14% respectively of the HCN yield. These products appear to arise through O atom intervention. Mechanisms for the reactions and the nature of the activated state in the initial step are discussed. (auth)

6019 REACTIONS OF BENZOYLTHIOACETIC ACID ANILIDES AND THEIR DERIVATIVES WITH CHLORIDES OF DICARBOXYLIC ACIDS. I. Zankowska-Jasinska, W.; Eilmes, J. (Jagellonian Univ., Krakow). Rocz. Chem.; 47: No. 12, 2235-2246(1973).

The reactions of benzoylthioacetic acid anilides and their derivatives with oxalyl chloride were investigated. The structure of the products with pyrrolidinethiotrione or thiazolidinedione system was discussed on the basis of chemical evidence and spectral data. (auth)

6020 CH_3-CD_3 ISOTOPE EFFECTS IN THE ACID CATALYSED DIENONE-PHENOL REARRANGEMENT. Vitullo, V. P.; Logue, E. A. (Univ. of Maryland, Baltimore). J. Chem. Soc., Chem. Commun.; No. 6, 228-229(20 Mar 1974).

$k(CH_3)/k(CD_3)$ has been determined for rate-determining methyl migration in the dienone-phenol rearrangement and is 1.144 ± 0.017. (auth)

6021 RATES AND HYDROGEN ISOTOPE EFFECTS IN THE IONIZATION OF 1,1-DINITROETHANE. Bell, R. P.; Tranter, R. L. (Univ. of Stirling, Eng.). Proc. Roy. Soc. (London), Ser. A; 337: No. 1611, 517-527(Feb 1974).

The pK of 1,1-dinitroethane was determined in aqueous solution, and rate constants measured for its reaction with nine bases. Rate constants were also obtained for the reaction of 1,1-dinitroethane-1-d with three of these bases. The isotope effects and the relation between rate and acid-base strength are compared with those observed for other carbon acids. (auth)

6022 FREE ENERGIES OF TRANSFER OF THE ALKALI-METAL HALIDES FROM LIGHT TO HEAVY AND TO ISOTOPICALLY MIXED WATER. Voice, P. J. (University Coll., Dublin). J. Chem. Soc., Faraday Trans., I; 70: No. 3, 498-505(1974).

The standard molar free energies of transfer of the alkali-metal chlorides and the sodium halides from light to heavy water and of sodium chloride from light to isotopically mixed water at 25°C have been measured using a concentration cell without transference. (auth)

6023 PHYSICAL PROPERTIES OF OXYGEN-17 WATER. Absolute Viscosity and Density of $H_2{}^{17}O$ Between 15 and 35°C. Kudish, A. I.; Wolf, D.; Steckel, F. (Weizmann Inst. of Science, Rehovoth, Israel). J. Chem. Soc., Faraday Trans., I; 70: 484-489(1974).

The absolute viscosity of four oxygen-17 water samples is reported at 5°C intervals between 15 and 35°C. The absolute viscosity of 100% $H_2{}^{17}O$ is determined by extrapolation of the measured viscosity of a highly enriched oxygen-17 sample, i.e., 86.53% ^{17}O. The values calculated, based upon Eyring's theory of viscosity, for the other oxygen-17 samples are in excellent agreement with the experimental results. The isotope effect has been analyzed for $H_2{}^{17}O$ relative to natural water. The viscosity ratio at 25°C for $H_2{}^{17}O/H_2{}^{16}O$ is 1.0226, whereas that for $H_2{}^{18}O/H_2{}^{16}O$ and $D_2{}^{16}O/H_2{}^{16}O$ is 1.0536 and 1.2316 respectively. (auth)

6024 ANION RADICAL OF TRIPHENYLMETHANE. Nasirov, R. N.; Prokof'ev, A. I.; Solodovnikov, S. P.; Kabachnik, M. I. (Inst. of Heteroorganic Compounds, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 22: No. 9, 1930-1933(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 22: No. 9, 1981-1984(Sep 1973).

The formation of primary anion radicals of triphenylmethane (TPM) in the reaction with K, Na, or their alloys in solutions of tetrahydrofuran and 1,2-dimethoxyethane was demonstrated. A kinetic isotopic effect of decomposition of the anion radicals of TPM, equal to 0.53, was detected. (auth)

6025 H_2O-D_2O SOLVENT ISOTOPE EFFECTS IN ADIABATIC COMPRESSIBILITY AND VOLUME OF ELECTROLYTES AND NON-ELECTROLYTES: RELATION TO SPECIFICITIES OF IONIC SOLVATION. Mathieson, J. G.; Conway, B. E. (Univ. of Ottawa). J. Chem. Soc., Faraday Trans., I; No. 4, 752-768(1974).

Adiabatic compressibilities and molar volumes of a number of simple inorganic salts (alkali metal halides) and tetraalkylammonium salts were measured in H_2O and D_2O. The infinite dilution values $\phi^\infty_{K,S}$ were obtained by extrapolations based on results determined down to 0.001 to 0.002 mol kg^{-1}, i.e. towards the Debye-Hückel limiting law region. With these $\phi^\infty_{K,S}$ values, hydration effects determining the solvent isotope difference of $\phi^\infty_{K,S}$ values in D_2O and H_2O are discussed in terms of electrostriction and differences of local rigidity or relaxation characteristics of the solvent lattice. The solvent isotope effects in $\phi^\infty_{K,S}$ are related to accessibility of the N^+ center in the organic ions investigated. Comparison with the isotope effects in the infinite dilution partial molal volumes indicate that the series of salts investigated can be classified into three groups according to the hydration behavior of the cations. The behavior of salts is compared with that of some neutral molecules, HOD and also some D-labelled acetic acids for which a secondary isotope effect is investigated. (auth)

6026 ISOTOPIC REACTIVE SYSTEMS $H+Cl_2$ AND $D+Cl_2$. A QUANTUM MECHANICAL TREATMENT OF THE COLLINEAR ARRANGEMENT. Baer, M. (Applied Optics Department, Soreq Nuclear Research Center, Yavne, Israel). J. Chem. Phys. 60: No. 3, 1057-1063 (1 Feb 1974).

An exact quantum mechanical study is performed of the collinear reactive systems $H+Cl_2$ and $D+Cl_2$. The surface applied in this work is a LEPS potential surface originally employed by Polanyi and co-workers. The main results are (i) a strong population inversion is found, the most populated levels being $v = 4$ for the HCl product and $v = 5$ for DCl; (ii) the initial vibrational state has very little influence on the rate of the reaction but strongly affects the final vibrational distribution of the product; (iii) the two isotopic systems behave very similarly (as a function of relative energy); (iv) at all points where there is a classical trajectory data there is a broad agreement with the quantum results. (auth)

6027 REACTION RATE OF BILIRUBIN WITH SINGLET OXYGEN ($^1\Delta_g$) AND ITS STRONG ENHANCEMENT BY ADDED BASE. Matheson, I. B. C.; Curry, N. U.; Lee, J. (Univ. of Georgia, Athens). J. Amer. Chem. Soc.; 96: No. 11, 3348-3351 (29 May 1974).

The oxidation of bilirubin by singlet oxygen produced by direct laser irradiation of the oxygen $^1\Delta_g + 1v \rightarrow {}^3\Sigma_g^-$ electronic transition was studied in Freon solution and in D_2O. In Freon 113 the bilirubin chemical reaction rate constant is 1.0×10^7 l. mol^{-1} sec^{-1} and in D_2O at pD < 7 within experimental error the same, 1.5×10^7 l. mol^{-1} sec^{-1}. At higher pD (>8) the reaction rate increases to 3×10^9 l. mol^{-1} sec^{-1}. This rate constant is about 30 times higher than our recently revised value for 1,3-diphenylisobenzofuran, hitherto thought to be the most rapidly reacting singlet oxygen acceptor. (auth)

6028 CH-CD AND H_2O-D_2O ISOTOPE EFFECTS ON THE FORWARD AND REVERSE RATES OF KETO-ENOL TAUTOMERIZATION OF ACETONE IN ACIDIC MEDIA. Toullec, J.; Dubois, J. E. (CNRS, Paris). J. Amer. Chem. Soc.; 96: No. 11, 3524-3532(29 May 1974).

The various isotope effects on the different steps of ketone enolization and enol ketonization have been isolated by kinetic measurements of the iodination and bromination of acetone and acetone-d_4, in normal and heavy water, in the presence of H_2SO_4 or $HClO_4$, and under conditions such that enolization and halogen addition to the enol occur at comparable rates. The H_2O-D_2O isotope effect (= 3.7) on the ketonization, corresponding to the ratio of the rate constants for addition of H^+ and D^+, is about the same as that observed for the hydrolysis of ethyl ether of acetone enol. This result is consistent with the Pedersen two-step mechanism for keto-enol tautomerization; the rate-determining step of ketonization is proton addition, similar to the attack of an enol ether in hydrolysis. In the transition state, the proton is half-transferred from water to substrate while the enol O-H bond is not affected. CH/CD (= 6.7) and H_2O-D_2O (= 0.54) isotope effects on the enolization rate constant are reevaluated. The variations of the ketonization and enolization rate constants in different H_2O-D_2O mixtures are also discussed. (auth)

6029 PHENOMENOLOGICAL MANIFESTATIONS OF QUANTUM-MECHANICAL TUNNELING. II. EFFECT ON ARRHENIUS PRE-EXPONENTIAL FACTORS FOR PRIMARY HYDROGEN KINETIC ISOTOPE EFFECTS. Stern, M.J. (Department of Chemistry, Belfer Graduate School of Science, Yeshiva University, New York, New York 10033, and University Chemical Laboratory, University of Kent at Canterbury, England); Weston, R.E. Jr. J. Chem. Phys. 60: No. 7, 2808-2814 (1 Apr 1974).

The effect of quantum-mechanical tunneling on the Arrhenius pre-exponential factor A_Q in reactions involving primary protium-deuterium kinetic isotope effects is investigated as a function of temperature. It is shown that large tunneling factors can either raise or lower A_Q considerably or leave it essentially unchanged from its value in the absence of tunneling, depending on the details of the reaction system involved and on the temperature range under consideration. It is concluded that experimental A_Q factors can be used as quantitative indicators of quantum-mechanical tunneling only in conjunction with model calculations. Experimental values of A_Q inside the "no-tunneling" range, $2^{-1} \leq A_Q \leq \sqrt{2}$, do not necessarily indicate the absence of large tunneling factors. (auth)

6030 PHENOMENOLOGICAL MANIFESTATIONS OF QUANTUM-MECHANICAL TUNNELING. III. EFFECT ON RELATIVE TRITIUM-DEUTERIUM KINETIC ISOTOPE EFFECTS. Stern, M.J. (Department of Chemistry, Belfer Graduate School of Science, Yeshiva University, New York, New York 10033); Weston, R.E. Jr. J. Chem. Phys. 60: No. 7, 2815-2821 (1 Apr 1974).

The effect of quantum-mechanical tunneling on relative tritium-deuterium kinetic isotope effects is investigated with the aid of model calculations. It is shown that even when tunneling is important, such relative effects, defined as $r = \ln(k_H/k_T)\,[\ln(k_H/k_D)]^{-1}$, have values not very different from their values in the absence of tunneling. Thus, for the types of reactions commonly used to investigate tunneling, the limits $1.33 \leq r \leq 1.58$ are not likely to be exceeded. There is no direct general correlation between the magnitude of r and the extent of tunneling; the temperature dependence of r is qualitatively the same for a wide range of reaction models and barrier heights. (auth)

6031 DEUTERIUM ISOTOPE EFFECT ON THE RADIATIONLESS DECAY OF THE LOWEST TRIPLET STATE OF A PORPHYRIN FREE BASE. Burgner, R.P.; Goncalves, A.M.P. (Department of Chemistry, The Pennsylvania State University, University Park, Pennsylvania 16802). J. Chem. Phys. 60: No. 7, 2942-2943 (1 Apr 1974).

Triplet state lifetimes of mesoporphyrin IX dimethyl ester free base (Meso) were measured in 3-methylpentane, C_2H_5OH and C_2H_5OD solutions at 77°K. A large deuterium isotope effect was observed on the radiationless decay of the lowest triplet state. (AIP)

6032 VIBRATIONAL SPECTRA AND NORMAL VIBRATIONS OF THIOPROPIONAMIDE AND N,N-DEUTERATED THIOPROPIONAMIDE. Usha Bai, P.; Venkata Ramiah, K. (Osmania Univ., Hyderabad, India). Indian J. Pure Appl. Phys.; 11: No. 10, 769-774(Oct 1973).

The infrared and Raman spectra of thiopropionamide and N,N-deuterated thiopropionamide have been recorded in the region 3500 to 200 cm^{-1}, and the spectral changes due to deuteration have been studied. The normal vibration analysis of thiopropionamide and N,N-deuterated thiopropionamide has been carried out using the general quadratic force field and the force constants have been refined by the method of damped least squares. The salient results that have been obtained in regard to the nature of the absorption bands and mixing of the skeletal frequencies have been presented in terms of the potential energy distribution of each normal mode in general quadratic space and among the various symmetry coordinates. The Cartesian displacements of the atoms for all the in-plane normal modes of thiopropionamide have been computed and the vibrational features of some of the normal modes are presented. (auth)

6033 DEUTERIUM EFFECT ON THE QUENCHING OF AROMATIC HYDROCARBON TRIPLET EXCITED STATES BY OXYGEN. Benson, R.; Geacintov, N.E. (Chemistry Department and Radiation and Solid Laboratory, New York University, New York, New York 10003). J. Chem. Phys. 60: No. 8, 3251-3257 (15 Apr 1974).

By using ultraviolet light flash excitation, the triplet (phosphorescence) decay time τ of a series of protonated (p) and deuterated (d) aromatic hydrocarbons dissolved in a fluffy freeze-dried polystyrene matrix was studied as a function of oxygen pressure [O_2] at 298°K. The quenching constants γ were calculated from linear plots of τ^{-1} as a function of [O_2] and the ratios of γ (p)/γ (d) are 1.2 ± 0.1 for anthracene and 1,2-benzanthracene, 1.9 ± 0.2 for pyrene, 1.4 ± 0.2 for chrysene, and 2.5 ± 0.4 for naphthalene. These results are interpreted in terms of Franck-Condon factors and the energy transfer quenching model proposed by Kawaoka, Khan, and Kearns in which the $^1\Delta_g$ and $^1\Sigma^+_g$ excited states of oxygen are generated, and in which the remaining energy is dissipated by the vibrational modes of the quenched aromatic molecules. In pyrene and in naphthalene, the $^1\Delta_g$ pathway appears to be more important than in chrysene and dominates over the $^1\Sigma^+_g$ mechanism. No conclusions can be reached about the preferred mode of energy transfer to oxygen in anthracene and 1,2-benzanthracene. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 7012.

6034 INFLUENCE OF TEMPERATURE ON THE HYDROGEN-TRITIUM SEPARATION FACTOR ON PLATINUM. Martins, M. E.; Calandra, A. J.; Arvia, A. J. (La Plata Univ., Nacional). Electrochim. Acta; 19: No. 2, 99-100(Feb 1974).

A preliminary report is presented on the influence of temperature on the hydrogen/tritium separation factor on bright platinum electrodes, a particularly active metal for the hydrogen electrode reaction. Measurements were in the range from -50 to 60°C, and were carried out in H_2SO_4 aqueous solutions, containing tritiated water. The hydrogen formed by electrolysis was oxidized to water, and the tritium content of the sample, as well as those of stock water and blank experiments, were determined with an automatic scintillation counter. (UK)

6035 PRECISION STUDY OF THE FRACTIONATION OF IRON ISOTOPES IN THE SYNTHESIS OF IRON PENTACARBONYL. Shadskii, I. P. (Moscow Inst. of the Petrochemical and Gas Industry). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 8, 1204-1205(Aug 1973).

Translated from Zh. Fiz. Khim.; 47: No. 8, 2131(Aug 1973).

The isotopic composition of iron in the iron pentacarbonyl specimens synthesized has been determined mass spectrometrically. Within experimental error, the isotopic compositions of the test specimens are identical. The accuracy of the measurements of $\delta^{57/54}$ Fe was $\pm(0.1-0.2)\%$. (auth)

6036 INFRARED STUDY OF HYDROGEN-DEUTERIUM EXCHANGE BETWEEN DEUTEROTOLUENES AND STRUCTURAL HYDROXYL GROUPS IN GAMMA-ALUMINA AND ALUMINA-SILICA. Berentsveig, V. V.; Kubasov, A. A.; Rudenko, A. P. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 8, 1183-1184(Aug 1973).

Translated from Zh. Fiz. Khim.; 47: No. 8, 2101(Aug 1973).

Deuterium-hydrogen exchange between 2,3,4,5,6-D_5- and methyl-D_3-toluene, and the structural hydroxyl groups in γ-Al_2O_3 and in an alumina-silica catalyst, was studied by ir spectroscopy at 25, 150, and 300°C. By using deuterotoluenes containing deuterium in different positions it was demonstrated that the surface OH groups of oxide catalysts interact preferentially with the aromatic nucleus of the toluene molecule. (auth)

6037 HYDROGEN-TRITIUM EXCHANGE IN POLYPEPTIDES. Models of α-Helical and β Conformations. Welch, W. H. Jr.; Fasman, G. D. (Univ. of Nevada, Reno). Biochemistry; 13: No. 12, 2455-2466(4 Jun 1974).

The rate of hydrogen-tritium exchange of the amide hydrogens for both the α-helical and β-sheet conformation of the same synthetic polypeptide was measured in aqueous media. A copolymer of L-glutamic acid and L-valine, poly($Glu^{77}Val^{23}$), was synthesized whose conformation at pH 4.1 can be varied by heating and cooling. A class of extremely slowly exchanging protons was found, which was directly correlated with the amount of β conformation in the copolymer. A greatly reduced rate of exchange was also observed in the soluble aggregate of α-helical poly(Glu), which was directly related to the degree of aggregation. It is suggested that extremely slow hydrogen exchange can be explained by conformation stabilization without restricting such hydrogens to the deep interior of macromolecules. The existence of the previously reported equilibrium isotope effect [Englander, S. W., and Poulsen, A. (1969), Biopolymers 7, 379] was observed to be 1.18 for both poly(DL-Lys) and the glutamic acid copolymer. (auth)

6038 STRUCTURE OF TRANS-CHLORO(METHYLIMIDO) TETRAKIS(METHYLAMINE)RHENIUM(V) PERCHLORATE. Shandles, R. S.; Murmann, R. K.; Schlemper, E. O. (Univ. of Missouri, Columbia). Inorg. Chem.; 13: No. 6, 1373-1377(Jun 1974).

The crystal structure of the trans-chloro(methylimido)tetrakis (methylamine)rhenium(V) ion, $[Re(CH_3NH_2)_4(CH_3N)Cl]^{2+}$, has been determined as its perchlorate salt, using scintillation counter techniques in a three-dimensional x-ray diffraction study. The compound crystallizes in the orthorhombic space group Pnam with unit cell dimensions a = 16.908 (4) Å, b = 8.641 (2) Å, and c = 12.759 (5) Å. The density of 2.045 (1) g/cm^3 calculated on the basis of four formula units per unit cell is in agreement with the flotation density of 2.01 (2) g/cm^3. The structure was resolved by Patterson and Fourier methods and refined by full-matrix least-squares treatment to a conventional R factor of 4.1% using

1066 independent reflections. The perchlorate ion is disordered. The rhenium is octahedrally coordinated with a chlorine and five nitrogens. The Re-Cl distance is 2.403 (5) Å. The methylimido group is trans to the Cl with the Re-N(imido) distance 1.694 (11) Å and the N(imido)-C distance 1.46 (2) Å. The Cl-Re-N(imido)-C grouping is linear; Cl-Re-N = 179.4 (6)° and Re-N-C = 180 (2)°. The remaining four amine nitrogens are arranged in a plane around the rhenium with the metal above the plane toward the imido nitrogen. The average Re-N(amine) distance is 2.18 (2) Å. The average N(imido)-Re-N(amine) angle is 95.4 (7)°. The rates of Cl^- hydrolysis and isotopic exchange in dilute HCl solution are compared. (auth)

6039 DISTRIBUTION OF ISOTOPES BETWEEN TWO PHASES. Kakihana, H.; Aida, M. (Tokyo Inst. of Tech.). Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 116, 39-52(Mar 1973).

The derivation of fundamental equations and an explanation of the relationships among the isotopic separation factor, reduced partition function ratio, and mole fraction are reported. The fundamental equations are derived in terms of reduced partition function ratios and mole fractions, reduced partition function ratios and stability constants, isotopic exchange equilibrium coefficients and mole fractions, and isotopic stability constants and mole fractions. The isotopic separation factors ϵ can be measured by separation experiment. The reduced partition function ratio f or the isotopic stability constants β-A and β-B can be estimated from spectroscopic study or infrared measurement for the part of ligand formation and from precise investigation, and β-A and β-B can be estimated by emf stability constant measurement or conductivity measurement for isotopes. The mole fraction χ can be determined directly by chemical analysis, and the element stability constant β can be estimated through the stability constant measurement for elements. In conclusion, these fundamental equations can be used in three different ways: (a) the prediction of the isotopic separation factor, (b) the estimation of the partition function ratio, and (c) the calculation of the mole fraction and the stability constant. In the equations representing ϵ for the system containing three different ligands, the first term is the sum of the effects caused by transfer of each chemical species $M X_n W_{lo}^0 V_{mn}^0$ from the first phase to the second phase. The fifth term is negligibly small. (Iwakiri, K.)

Feed Materials Processing

Refer also to abstracts 6531 and 6532.

6040 (IEA-274) PROCESSING OF A URANIFEROUS ZIRCONIUM ORE. Brown, A. E. P.; Costa, E. C. (Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Engenharia Quimica). Sep 1972. 9p. INIS.

A processing scheme for caldasite, a mixture of zircon and baddeleyite abundant in the Poços de Caldas Plateau, was investigated aiming at a joint recovery of the uranium and zirconium values of the ore. The uranium-zirconium and iron-zirconium separations were done by precipitation of basic zirconium sulfates. The uranium was recovered by extraction of the mother liquor from the first zirconium precipitation by employing Alamine 336 in an inert diluent. End products are sodium diuranate and a commercial grade of zirconium oxide. Estimated production costs compared favorably with Brazilian import prices. (INIS)

Radiation Chemistry

Refer also to abstracts 6114, 6166, 6832, 6837, 6842, 7534, and 7543.

6041 (BARC/I-135, pp 15-21) RADIOLYSIS OF HYDROCHLORIC ACID SOLUTIONS OF PLUTONIUM(III). Natarajan, P. R.; Nagar, M. S. (Bhabha Atomic Research Centre, Bombay). 1971.

The results of radiolysis by gamma irradiation of both argon-equilibrated and oxygen-equilibrated solutions of 10^{-3} M plutonium(III) in 0.8 N HCl are presented in terms of the radiolysis yields of plutonium(IV) and hydrogen peroxide. Reaction mechanism is discussed with reference to the dose rate. Experiments on the "after-effect" show that there is negligible interaction between the radiolytically produced plutonium(IV) and hydrogen peroxide. However, in case of radiolysis of plutonium(IV) solutions by high doses of radiation, a considerable after-effect involving the reduction of plutonium(IV) by the radiolytically produced hydrogen peroxide is observed. (INIS)

6042 (BARC/I-135, pp 21-24) RADIOLYSIS OF NITRIC ACID SOLUTIONS OF PLUTONIUM. Natarajan, P. R.; Doctor, Z. K. (Bhabha Atomic Research Centre, Bombay). 1971.

The results of radiolysis by gamma irradiation of both argon-equilibrated and oxygen-equilibrated solutions of 10^{-3} M plutonium(III) in 0.8 N nitric acid are presented in terms of the radiolysis yields of plutonium(IV) and nitrous acid as a function of radiation dose. (INIS)

6043 (BARC/I-135, pp 26-31) RADIATION CHEMISTRY OF AQUEOUS NITRIC ACID SOLUTION. Bhattacharyya, P. K.; Saini, R. D. (Bhabha Atomic Research Centre, Bombay). 1971.

To understand the mechanism of gamma radiolysis of aqueous nitric acid solution, it is essential to accurately measure yields of its radiolytic products, namely, HNO_2 and H_2O_2, which react with each other rapidly and thus make their accurate estimation difficult on their radiolytic generation. Studies have been carried out to develop a method that uses sulfanilamide as an additive to form diazonium species with HNO_2 in preference to reaction with H_2O_2. The results indicate that 0.02 M sulfanilamide effectively protects HNO_2 from reacting with H_2O_2. Results of the studies on radiolysis yields of HNO_2 as a function of HNO_3 are presented and discussed. (INIS)

6044 (BNL-18790) MECHANISMS OF AEROSOL FORMATION FROM SO_2. Wood, W. P.; Castleman, A. W. Jr.; Tang, I. N. (Brookhaven National Lab., Upton, N. Y. (USA)). Mar 1974. 19p. (CONF-740614-2). Dep. NTIS $4.00.

From Air Pollution Control Association meeting; Denver, Colorado, USA (10 Jun 1974).

Experiments were performed to elucidate some of the mechanisms of important reactions leading to aerosol formation involving SO_2 and mixtures with NO_2. In one series, the rapid generation of a high number density aerosol was effected upon exposing 1 ppM of SO_2 to ionizing radiation in the presence of moisture. Subsequent addition of NH_3 led to further chemical conversion, the product being identified as $(NH_4)_2SO_4$ by x-ray diffraction. Mass spectrometric studies of the gas phase showed the expected reaction sequence leading to the formation of H_3O^+ hydrates and the hydroxyl radical. Additional experiments with an ion trap and appropriate free radical scavengers proved that aerosol formation did not involve an ion-molecule switching reaction; but, rather, the reaction of OH with SO_2 was found to be an important initiating step. The kinetics of the oxidation and subsequent hydration reactions leading to aerosol formation are discussed. In other experiments, a systematic investigation of aerosol formation involving NO_2, SO_2, and water vapor was undertaken. In the absence of organic impurities, no dark reaction leading to aerosol formation was observed for concentrations up to 1000 ppM of the reacting gases. However, upon exposure to light, $3000 \leq \lambda \leq 4900$Å, aerosol production occurred. At low reactant concentrations, the kinetics of particle formation are shown to depend directly on SO_2 concentration. Above a certain minimum level, particle formation is independent of NO_2. (auth)

6045 (JAERI-5029) FUNDAMENTAL STUDIES IN OSAKA LABORATORY FOR RADIATION CHEMISTRY. Annual Report, April 1, 1972-March 31, 1973. (Japan Atomic Energy Research Inst., Neyagawa, Osaka. Osaka Lab. for Radiation Chemistry). Mar 1974. 169p. (In Japanese). Dep. NTIS (US Sales Only) $11.50.

Studies carried out in the Osaka Laboratory for Radiation Chemistry during the fiscal year of 1972 are the basic studies directed toward applied radiation chemistry and are classified into two fields: the studies on the fundamental processes of radiation chemistry, and the radiation chemistry of polymers. Progress in the following studies is reported: radiation-induced polymerization of octadecyl acrylate at nitrogen-water interface and vinyl stearate monolayer at gas-water interface; gamma radiation effects on monomer-clay complexes; radiation-induced emulsion polymerization of vinyl acetate by electron beam irradiation; radiation-induced graft copolymerization to polyester; and radiation curing. (LK)

6046 (JAERI-M-5422) CHEMORHEOLOGY OF TETRAFLUOROETHYLENE-PROPYLENE ELASTOMER. Okamoto, J.; Ito, M.; Matsuda, O.; Suzuki, N. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 15p. (In Japanese). NTIS (US Sales Only).

The chemical stress relaxation of radiation-cured tetrafluoroethylene-propylene elastomer was measured at temperatures of 80 to 150°C to study the degradation mechanism. The copolymer is scissioned at the links of polymer chains and the degradation rate of elastomer irradiated in vacuo is higher than that in air. For the doses of above 9 Mrad, the number of chain scissions in the elastomer is 4×10^{-4} mole/cc; it is not dependent on temperature and initial cross-linking density. In the measurements of intermittent stress relaxation at the same temperature, the amount of thermal cross-linking keeps constant for the elastomer radia-

tion-cured in vacuo, independent of the temperature. These results indicate that the factor governing the relaxation and degradation is already present during the process of irradiation. The elastomer has thermal properties superior to those of other synthetic elastomers. (auth)

6047 (RFP-2140) RADIATION EFFECTS ON ION EXCHANGE RESINS. I. Gamma Irradiation of Dowex 50W. Kazanjian, A. R.; Horrell, D. R. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 10 May 1974. Contract AT(29-1)-1106. 8p, Dep. NTIS $4.00.

Dowex ® 50W ion exchange resin was gamma irradiated in the air-dried state and in 0.1N HCl. In both cases, the exchange capacity on a dry-weight basis was reduced about 30% upon absorption of 5×10^8 rads. This loss corresponded to the amount of sulfate ion produced from the sulfonic-acid functional groups by radiation. Changing the cation sorbed on the resin from H^+ to Na^+ had little effect on the degradation. (auth)

6048 (RRL-3238-479) QUARTERLY REPORT, JANUARY 1, 1974-MARCH 31, 1974. (Mellon Inst. of Science, Pittsburgh (USA). Radiation Research Labs.). 22 Apr 1974. Contract AT(11-1)-3238. 17p. Dep. NTIS $4.00.

Abstracts of paper published from work in radiation chemistry are included. Most of the work was concerned with the study of radicals-radiolysis studies, ESR studies, and studies of the reactions of various radicals. (LK)

6049 (SGAE-2009) RADIOLYTIC DECOMPOSITION OF PERFLUOROMETHYLCYCLOHEXANE. II. Dependence on Dose, Dose Rate, Temperature, Type of Radiation, and Oxygen Content. Gehringer, P.; Proksch, E.; Krenmayr, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Apr 1972. 25p. (In German). (CH-79-72). INIS.

The radiolysis of perfluoromethylcyclohexane was measured over a wide range of experimental conditions. The total decomposition under gamma irradiation amounts to about 3.1 molecules/100 eV and shows little or no dependence on dose, dose rate, and oxygen content of the sample. It increases slightly with increasing temperature and decreases to about half its value when changing to fast neutron irradiation. This behavior and the virtual absence of oxygen-containing radiolysis products lead to the conclusion that the radiolysis mechanism is mainly ionic. With respect to the use of the title compound as a neutron intensive dosimeter, measurement of total decomposition or of perfluorocyclohexane production is being proposed. (auth)

6050 UNSTABLE INTERMEDIATES. Pt. 141. Electron Spin Resonance Spectra of Various Tin and Lead Centres in Their Irradiated Salts. Starkie, H. C.; Symons, M. C. R. (Leicester Univ., Eng.). J. Chem. Soc., Dalton Trans.; No. 7, 731-735(1974).

In addition to Sn^{3+} and Pb^{3+} centers previously reported (Booth et al., J. C. S. Dalton; 2233(1973)) the following have been detected in a range of tin(II) and lead(II) salts after exposure to ^{60}Co γ rays at 77°K: Sn^+ [in $Sn(OAc)_2$]; Pb^+ [in $Pb(OAc)_2$]; SnH^{2+} [in $SnSO_4$]; PbH^{2+} [in $Pb(ClO_4)_2$]; $CO_2^-(Pb^{2+})$ [in $Pb(HCO_3)_2$]; $H_2\dot{C}CO_2^-(Pb^{2+})$ [in $Pb(MeCO_2)_2$]; and $ClO_3(Pb^{2+})$ [in $Pb(ClO_4)_2$]. After attempting to justify these identifications, the electronic structure of these centers is discussed in the light of the ESR parameters. (auth)

6051 ESR SPECTRUM OF IRRADIATED SOLID DECALIN. Bichiashvili, A. D.; Tsomaya, N. N.; Nanobashvili, H. M. (Inst. of Inorganic Chemistry and Electrochemistry, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 73: No. 3, 617-620(Mar 1974). (In Russian).

An ESR spectrum consisting of 12 lines has been obtained by irradiation of solid decalin at 77°K with the dose of 30 Mrad. This spectrum has been assigned to bicyclo-[4, 4, 0]-decyl-1 radicals formed from trans-decalin by the abstraction of the hydrogen atom from the tertiary atom of carbon. Unpaired electron interacts with three axial and two equatorial protons with splitting constants 38.5 and 9G respectively. (auth)

6052 STATIONARY CONCENTRATION OF AMMONIA REACHED AFTER PROLONGED RADIOLYSIS AND BY RADIOLYSIS OF A NITROGEN-HYDROGEN MIXTURE. Schoenherr, S.; Schrader, R. (Bergakademie, Freiberg i. B.). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 426-427(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 478-479(1973).

The aim of the work reported was to determine the value of the stationary ammonia concentration from irradiations of the stoichiometric mixture of nitrogen and hydrogen and also of pure ammonia, using mixed reactor irradiations under normal conditions and in the absence of a catalyst. Experimental results for the synthesis and destruction of ammonia are given. In both systems the same stationary concentration (4.0 ± 0.1%) of ammonia is reached; the dose necessary to achieve this exceeds 5×10^{19} rads. The results show that the irradiation of $N_2 + H_2$ systems is not promising for the industrial production of ammonia if the irradiation is carried out under normal conditions in the absence of a catalyst. (LK)

6053 RADIATION-INITIATED CANNIZZARO REACTION IN AQUEOUS SOLUTIONS OF FORMALDEHYDE. Gorbachev, V. M.; Kalyazin, E. P.; Petryaev, E. P. (Belorussian State Univ., Minsk). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 420-421(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 474-475(1973).

The results of a study on the radiolysis of aqueous solutions of formaldehyde are presented. The study was made to examine the possibility of a radical mechanism for the Cannizzaro reaction. (LK)

6054 RADIATION VULCANIZATION OF LOW-MOLECULAR-WEIGHT RUBBERS. Fedoseeva, T. S.; Kuz'minskii, A. S. (Scientific-Research Inst. of the Rubber Industry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 424-425(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 477-478(1973).

Radiation-initiated polymerization of polyfunctional compounds gives rise to the formation of three-dimensionally cross-linked polymers. The possibility of carrying out this process by the gamma radiation of low-molecular-weight (3000-5000) bifunctional rubbers was studied with the aim of producing elastic materials. Experimental results show that the formation of cross-links in such systems occurs at a greater rate than in high-molecular-weight rubbers of similar chemical structure, owing to the occurrence of a three-dimensional polymerization process in which the unsaturated bonds of the methacrylate groups participate. (LK)

6055 EFFECT OF ALKALI ON THE RUPTURE OF C-O AND C-C BONDS IN THE RADIOLYSIS OF AQUEOUS SOLUTIONS OF ALCOHOLS. Afanas'ev, A. M.; Kalyazin, E. P. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 418-419(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 472-474(1973).

Results are presented which indicate that alkali has an important effect on the product yields from the gamma radiolysis of aqueous solutions of n-propanol and isopropanol, arising from the rupture of C-O and C-C bonds. The gaseous products were determined by gas chromatography. (LK)

6056 MECHANISM OF THE REACTION ON HYDROXYALKYL RADICALS WITH H_2O_2. Kalyazina, N. S.; Kalugin, K. S.; Moskalev, Yu. I. (Inst. of Biophysics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 416-417(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 471-472(1973).

The reaction of hydroxyalkyl radicals with H_2O_2 is one of the paths to the formation of carbonyl compounds in the radiolysis of aqueous solutions of alcohols. This study attempted to determine which of the H atoms in the hydroxyalkyl radical participates in this process, taking as an example the reaction of $(CH_3)_2\dot{C}OT$ free radicals formed during the gamma radiolysis of a solution of isopropanol and H_2O_2 in water containing tritium. Results of this study show that the most probable reaction of the hydroxyisopropyl radical with H_2O_2 is that in which the hydroxyl hydrogen is abstracted. (LK)

6057 METHOD OF CALCULATING LIMITING CONCENTRATIONS OF RADIOLYSIS PRODUCTS. Bulanov, L. A.; Borovkov, V. V.; Borisov, E. A. (Inst. of Physical-Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 412-413 (1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 468-469(1973).

Determination of the limiting concentration of a given radiolysis product is one of the most important requirements in radiation chemistry, especially if a particular reaction is considered from the point of view of synthesizing the given product. Use of an additive method for determining this quantity is discussed. The method is applied to the radiolytic synthesis of ethylene glycol from methanol. (LK)

6058 EFFECT OF 500-keV PROTONS ON POLYMETHYLPHENYLSILOXANE. Akishin, A. I.; Pankratova, L. N.; Zheleznikova, M. V.; Titov, V. I. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 406-408(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 462-464(1973).

The effect of 500-keV protons on polymethylphenylsiloxane (PMPS) in the dose range $1.5\text{-}7.5 \cdot 10^9$ Mrad has been studied by ir spectroscopic methods. The samples were first subjected to different thermal treatment at 20, 120, and 200°C. It was found that PMPS held at 200°C undergoes less radiolytic damage. The consumption of methyl groups decreases as the temperature is increased from 20 to 200°C. The ir spectroscopy using the double-beam method showed bands due to cross-linking in the 990-1020 cm^{-1} region in irradiated samples. (auth)

6059 REACTIONS OF STABLE IMINOXYL RADICALS WITH ALKYL RADICALS IN THE RADIOLYSIS OF OCTANE. Livertovskaya, T. Ya.; Romantsev, M. F.; Sudnik, M. V.; Lukashenko, I. M.; Brodskii, E. S. (All-Union Scientific-Research Inst. of Petroleum Refining, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 402-405(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 458-461(1973).

A study was carried out of the mechanism by which the radiolytic oxidation of octane is inhibited by 2, 2', 6, 6'-tetramethylpiperidinoxyl-1 (TMPO). Thin-layer chromatography was used to separate the radiolysis product containing TMPO; the ir, uv, and mass spectra of this product were obtained. It was found that during radiolysis TMPO reacts with alkyl radicals from octane in both the presence and absence of oxygen; addition occurs mainly to the secondary carbon atom of the alkyl radical. The results support our earlier suggestion that iminoxyl radicals are active acceptors, competing with oxygen for the capture of alkyl radicals. (auth)

6060 RADICAL PAIRS IN THE LOW-TEMPERATURE RADIOLYSIS OF DIKETOPIPERAZINE SINGLE CRYSTALS. Serdobov, M. V.; Aleksandrov, A. I.; Lebedev, Ya. S. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 387-391(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 439-444(1973).

In the low-temperature γ radiolysis of diketopiperazine-d_2 there are formed not only isolated radicals, but also radical pairs of two types, differing by their position in the crystal lattice and by the distances between the unpaired electrons (4.5 and 6.3 ± 0.05 Å). A mechanism is proposed for the formation of radical pairs and the kinetics of their disappearance during annealing is examined. (auth)

6061 NITROGEN FORMATION FROM THE RADIOLYSIS OF THE SYSTEM n-HEPTANE–PYRIDINE–NITROUS OXIDE. Zatonskii, S. V.; Pupov, A. P.; Saraeva, V. V. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 374-377(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 424-428(1973).

Measurement of the nitrogen yield from the γ radiolysis of the system n-heptane–pyridine–nitrous oxide showed that, in addition to the main reaction of nitrous oxide with electrons, another reaction causing its decomposition occurs. Using the stationary state method, ratios of the rate constants for the competing reactions, including reactions of pyridine and nitrous oxide with electrons, were evaluated. The radiation yield of electrons is 4.4 molecules/100 eV, while the yield of primarily excited n-heptane molecules reacting with nitrous oxide is 0.8 molecules/100 eV. (auth)

6062 SPECTRAL CHARACTERISTICS AND YIELDS OF LOCALIZED ELECTRONS IN THE PULSE RADIOLYSIS OF CRYSTALLINE ICE. Pernikova, T. E.; Shublin, V. N.; Kabakchi, S. A.; Sydykova, D. S. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 378-381 (1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 429-433(1973).

Using pulse radiolysis with spectrophotometric recording of e^-_{aq} in neutral crystalline ice and in ice containing acid (HF and $HClO_4$) or base (KOH), investigations were carried out on the spectral properties and radiation yields of e^-_{aq} over the temperature range 273 to 213°K. The energy at the maximum in the e^-_{aq} absorption band was found to be 1.816 eV at 273°. The temperature coefficient of the displacement in the maximum is $\partial E\lambda_{max}/\partial T = -1.0 \cdot 10^{-3}$ eV/deg, independent of the matrix composition. The halfwidth of the e^-_{aq} absorption spectrum does not depend on temperature (273-213°) and has the values (eV): in neutral ice 0.763 ± 0.024; in ice with HF 0.742 ± 0.028; in ice with $HClO_4$ 0.840 ± 0.012; and in ice with KOH 0.794 ± 0.028. In ice close to 273° $G_{e^-_{aq}} = 0.9 \pm 0.1$ particles/100 eV. The temperature dependence of the e^-_{aq} yield does not depend on the matrix composition; an equation for this dependence was derived. (auth)

6063 RADIOLYSIS OF DEAERATED AQUEOUS SOLUTIONS OF ETHYLENE GLYCOL. Kartasheva, L. I.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 382-386(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 434-438(1973).

The γ radiolysis of deaerated acid, neutral, and alkaline aqueous solutions of ethylene glycol was investigated. The yields of hydrogen peroxide, acetic, succinic, and glycolic aldehydes, and formaldehyde were measured as functions of ethylene glycol concentration, dose, and dose rate. In an alkaline medium there was a significant change in the composition of the carbonyl compounds. In particular, glycolic aldehyde was not formed in this medium, unlike the results in acid and neutral solutions. In all the media the yields of carbonyl compounds depended on the ethylene glycol concentration and dose rate and are characterized by comparatively high values, the highest yields being reached in an alkaline medium. A chain mechanism is proposed for the formation of carbonyl compounds, the CH_2CHO radical playing an important part in neutral and acid media, the $CH_2 = C - O^-$ ion-radical in an alkaline medium. (auth)

6064 ISOTHERMAL DESTRUCTION OF ACTIVE PRODUCTS IN THE RADIOLYSIS OF POLYMERS. Stepwise Radical Destruction. Aulov, V. A.; Sukhov, F. F. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 5, 363-368(1973).

Translated from Khim. Vys. Energ.; 7: No. 5, 412-417(1973).

Molecular motion in polymers is a determining factor in the destruction of active radiolysis products. From the relaxation character of the molecular motion it follows that the active particles undergo isothermal destruction; the form of the spectrum of relaxation times leads to a decrease in the rate of this destruction according to a first-order exponential function. This law was verified experimentally for a number of polymers at different temperatures. The available literature data indicate that this law is fulfilled for the destruction of charged particles in low molecular weight hydrocarbons and some solid solutions of amines at low temperatures, as well as for radical destruction in polyethylene at room temperature. The concepts developed explain the experimentally observed stepwise destruction of radicals in irradiated hydrocarbons. (auth)

6065 RADIOLYSIS OF THE COMPLEX OXALATES IN AQUEOUS SOLUTIONS. II. Kinetics and Mechanism of the Radiolysis of Cobalt–Trisoxalato Complex in Neutral Aqueous Solution with α-^{210}Po Irradiations. Murgulescu, I. G.; Paun, J. (Bucharest Univ.). Rev. Roum. Chim.; 19: No. 1, 9-15(Jan 1974).

The decomposition of the Co-trisoxalato-complex in neutral aqueous solution by irradiation with high LET ionizing radiation (α-^{210}Po) was studied. The radiochemical decomposition reaction follows a zero-order kinetic law. The $G(-[Co(C_2O_4)_3]^{3-})$ value increases with the increasing solute concentration from 0.22 to 0.52, being in accordance with the known influence of LET value on the radiochemical yield of the solute chemical transformation in radiation chemistry of aqueous solutions. The predominant process in the radiolysis of this compound is the reduction of the trisoxalato-complex ion by the hydrated electrons and hydrogen atoms: $[Co(C_2O_4)]^{3-} + e^-_{aq} \rightarrow [Co(C_2O_4)_2]^{2-} + C_2O_4^{2-}$ and $[Co(C_2O_4)]^{3-} + H \rightarrow [Co(C_2O_4)_2]^{2-} + C_2O_4H^-$ so that: $G(-[Co(C_2O_4)_3]^{3-}) = G_{e^-_{aq}} + G_H$. (auth)

6066 γ-RADIOLYSIS OF GASEOUS ISOBUTYLENE. The Influence of Experimental Conditions on the Radiochemical Yields of the Main Radiolysis Products. Bica, I.; Caldararu, M. (Inst. of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 19: No. 1, 17-23(Jan 1974).

The γ radiolysis of gaseous isobutylene under a wide range of pressures (150 to 760 torr) and at different irradiation doses was studied. The influence of pressure, irradiation dose, and air traces on the yield of hydrogen and methane formation is discussed. Some ways that may determine the molecular hydrogen formation are also suggested. (auth)

6067 EXPERIMENTAL DATA OBTAINED BY PULSE RADIOLYSIS APPLIED TO GASES. Absorption Spectrum of the Radical N_3. Contineanu, M.; Schindler, R. N. (Bucharest Univ.). An. Univ. Bucuresti, Chim.; 21: No. 1, 107-112(1972). (In Rumanian).

Using the technique of pulse radiolysis for gases, the fraction lost when light passes through a quartz window was determined. The law of Lambert-Beer was verified as a function of the number of passings of the analyzing light through the irradiation cell. The absorption spectrum of radical N_3 was obtained by the radiolysis of $(CH_3)_3SiN_3$ vapor. (auth)

6068 POSTIRRADIATION CHANGES IN THE SOLUTIONS OF ACETYLACETONE. Cech, R. (Komenskeho Univ., Bratislava). Chem. Zvesti; 28: No. 1, 47-50(1974).

On irradiation of aqueous solutions of acetylacetone the reactions of acetylacetone with the products of the radiolysis of water take place and give carboxylic acids. The proposed mechanism assumes the formation of an unstable cyclic peroxide and its successive decomposition into carboxylic acids. In irradiated methanolic solutions of acetylacetone such reactions do not take place because the products of the radiolysis of methanol do not form peroxide with acetylacetone. (auth)

6069 MECHANISM OF ACTION OF SUPEROXIDE DISMUTASE FROM PULSE RADIOLYSIS AND ELECTRON PARAMAGNETIC RESONANCE. Evidence that Only Half the Active Sites Function in Catalysis. Fielden, E. M.; Roberts, P. B.; Bray, R. C.; Lowe, D. J.; Mautner, G. N.; Rotilio, G.; Calabrese, L. (Inst. of Cancer Research, Sutton, Eng.). Biophys. J.; 139: No.1, 49-60(Apr 1974).

Detailed studies on the mechanism of the enzymic reaction of

bovine superoxide dismutase were carried out by using pulse radiolysis and electron paramagnetic resonance (EPR). The second-order rate constant for the reaction between superoxide dismutase and the superoxide ion was redetermined as $(2.37 \pm 0.18) \times 10^9$ m^{-1} s^{-1} at 25°C. This reaction governs the turnover, and any first-order steps must have rate constants higher than about 10^4 s^{-1}. Turnover had a low activation energy and was slowed substantially when the viscosity was increased with glycerol, confirming that the reaction rate was near the limit for diffusion control. In water a reversible conformation change to a less active form appeared to take place above about 40°C. Pre-steady-state rates of reduction and reoxidation of copper in the enzyme are consistent with these processes being rate-limiting in enzyme turnover. Examination, with the help of computer simulation, of the EPR spectra at 9 and 35 gHz of native superoxide dismutase indicated that, apart from 10 to 20% of impurities, only one species of Cu^{2+} was distinguishable. The specific activity of the enzyme preparations used, measured by pulse radiolysis, was at least as high as that obtained by other workers. Measurement of the proportion of copper present as Cu^{2+} (determined both optically and by EPR spectroscopy) in the steady states approached from both the oxidized and the reduced forms of the enzyme, indicated (after allowing for the impurities) that only half of the copper atoms participated in turnover. EPR spectroscopy provided no evidence for differences between functioning and nonfunctioning Cu^{2+} atoms. It is suggested that the results may be best interpreted in terms of an allosteric type of mechanism, with two initially indistinguishable copper atoms in the enzyme. Reaction of one of these with a superoxide ion then renders the other, at least transiently, unreactive. (auth)

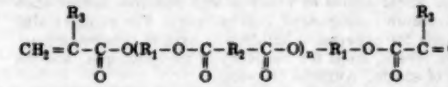
6070 STERILIZATION OF DISPOSABLE PLASTIC MAGAZINES FOR SURGICAL SUTURING APPARATUS. Prokopenko, T. L.; Volkov, A. M.; Korol'kov, I. A.; Ramkova, N. V.; Kareev, N. V.; Chudnova, L. B. (All-Union Scientific-Research Inst. of Medical Instrument Manufacture, Moscow). Biomed. Eng. (USSR) (Engl. Transl.); 7: No. 1, 33-35(1973).

Translated from Med. Tekh.; 7: No. 1, 35-37(1973).

Investigations were carried out on the gas and radiation sterilization of packaged plastic magazines of surgical suturing apparatus and to determine the effect of gas and radiation sterilization on the physical and mechanical properties of these magazines. The magazines used were made from polycarbonate resin (TU 6-16-1450-69) and impact-resistant polystyrene (STU 36-13-153-65); the magazines were loaded with staples of metal 40KKhNM and packed in a double polyethylene film of thickness 60-200 μm. Effective methods of gas sterilization were worked out with pure ethylene oxide, a mixture OB (a mixture of ethylene oxide and methyl bromide), Freoxide (ethylene oxide 11% and Freon 11 and 12), and Carboxide (ethylene oxide 10% and carbon dioxide 90% by weight) at a relative humidity of 80 to 100% and loading of the sterilizers to 80% of their volume. After sterilization by the gas method, the articles must be aired under room conditions for 3 to 4 days in order to remove residues of sterilizing gases. In development of radioinduced methods of sterilization, the plastic magazines were γ-irradiated in air in a dry state. A dose of 2.5 Mrad was found to guarantee sterilization. The microhardness and stability of the dimensions of the sterilized articles were not found to be affected by either method of sterilization. (JGB)

6071 METHOD FOR FORMING A COATING LAYER WITH LOW ENERGY ELECTRON BEAMS. Ide, F.; Kimura, T.; Kodama, T.; Harada, H.; Kobayashi, J. (to Mitsubishi Rayon Co. Ltd.). Japanese Patent 1973,22164. 8 May 1968. 4p. (In Japanese).

The coating material is produced by a method in which polymerization and hardening take place simultaneously and quickly, induced by electron beam irradiation. The coating is applicable to metals, concrete, asbestos, paper plastics, hard boards, insulating boards, etc., because of its superior hardness, impact strength, and durability in oils, chemicals, or boiling water. The compound (A) used in this method has the general formula:



where R_1 and R_2 are aliphatic, alicyclic, or aromatic hydrocarbons or their derivatives, and R_1 can include $-O-$ on its main chain; R_2 may include $-O-$, $-S-$ or $-SO_2-$ on its main chain; R_3 is methyl group or hydrogen; and n is integer 1 to 20. This method involves the polymerizing and hardening of the compound (A) alone or in a mixture of 10 to 90% by weight of the compound (A) and 90 to 10% by weight of vinyl monomer mixture (B) containing not less than 10% of alkyl acrylate ester and/or alkyl methacrylate ester by the irradiation of electron beams from an accelerator of 0.1 to 20 MeV with a dose of 0.5 to 30 Mrad. (JA)

6072 KINETICS OF THE GRAFT COPOLYMERIZATION OF GASEOUS METHYL METHACRYLATE, ON γ IRRADIATED POLYETHYLENE. Correia, P. B.; da Bandeira, M. H. S.; Novais, H. M. (Junta de Energia Nucleare, Sacavam, Portugal). Rev. Port. Quim. (Lisbon); 12: 77-84(1970).

Copolymerization of methyl methacrylate in the gaseous phase with gamma-irradiated polyethylene powder was studied. The kinetic of this reaction is analyzed on the basis of EPR spectra and absorption measurements and a model is proposed to interpret the reaction mechanism. Actual results allow the conclusion that EPR and absorption data together may be very helpful in the analysis of copolymerizations. (auth)

6073 SYNTHESIS OF NEW POLYMERS BY DESTRUCTIVE METHODS. I. Mechanochemical Polycondensation and Polycondensation by ^{60}Co γ-Irradiation of Poly(ethyleneterephthalate) with Ethylenediamine. Simionescu, C.; Vasiliu-Oprea, C.; Negulesnu, C. (Polytechnic Inst. of Jassy, Romania). Eur. Polym. J.; 10: No. 1, 61-70(Jan 1974).

Destruction of heterochain polymers, such as poly(ethyleneterephthalate), achieved under the action of mechanical energy or of γ-rays, is accompanied by the accumulation of an increasing number of functional end-groups, which are able to react with suitable difunctional reagents. Thus, processes are greatly influenced by conditions, e.g., processing time, ratio of reactants, temperature and atmosphere (inert, oxygen, etc), in which the reaction occurs. The polycondensation products so obtained exhibit properties different from those of the original polymer, viz. increased thermal stability, permanent magnetic moment and chemical resistance. (auth)

6074 RADIATION CHEMISTRY OF DNA MODEL COMPOUNDS. III. γ-Radiolysis of 2-Deoxy-D-Ribose in the Crystalline State. Conversion of 2-Deoxy-D-Ribose into 2,5-Dideoxy-D-Erythro-Pentonic Acid Via a Chain Reaction. von Sonntag, C.; Neuwald, K.; Dizdaroglu, M. (Max-Planck-Institut fuer Kohlenforschung, Muelheim, Ger.). Radiat. Res.; 58: No. 1, 1-8(Apr 1974).

In the γ-radiolysis of crystalline 2-deoxy-D-ribose, 2,5-dideoxy-D-erythro-pentonic acid is formed via a chain reaction with an initial G value >650. (auth)

6075 USE OF TRANSITION EFFECTS IN THE ANALYSIS OF MULTICOMPONENT ESR SPECTRA. Gol'din, S. I.; Markevich, S. V.; Stel'makh, V. F.; Strigutskii, V. P. (Belorussian State Univ., Minsk). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 8, 1173-1175(Aug 1973).

Translated from Zh. Fiz. Khim.; 47: No. 8, 2087-2088(Aug 1973).

Analysis of the form of dispersion signals under the conditions of rapid transition through resonance was used to separate various types of paramagnetic centers in the multicomponent spectra of γ-irradiated glucose and its high-molecular-weight polymer dextran. The presence of a signal due to free radicals produced by dissociation of the C–O bond between the anhydroglucose units was detected with the aid of the dextran. (auth)

6076 RADIO- AND PHOTO-THERMOLUMINESCENCE OF FROZEN SOLUTIONS OF SULFURIC ACID CONTAINING UO_2SO_4, $FeSO_4$, AND QUININE SULFATE. Kazakov, V. P.; Korobeinikova, V. N.; Parshin, G. S. Zh. Prikl. Spektrosk.; 20: No. 1, 69-75 (Jan 1974). (In Russian).

A study was made of the thermoluminescence (TL) observed after x-ray and ultraviolet irradiation of solutions of UO_2^{++}, Fe^{2+} and quinine sulfate in concentrated and 5 mol/l H_2SO_4. Isothermal post-emission at 77°K follows a second-order kinetic process and indicates that recombination is taking place. The regions of Tl peaks are compared with known temperatures for the death of unstable, acid radiolysis products. It is shown that the low-temperature (115°K) Tl peak is not connected with the death of activated hydrogen atoms H^*. It is proposed that this peak is caused by a thermal release from fine traps of a small number of solvated electrons not recorded by EPR, which have avoided capture by protons. The Tl peak in the region of 183°K coincides with structural transitions "hard glass-soft glass." An anomalously high activation energy (~3 eV) corresponding to this peak was obtained. In the same temperature region the death of SO_4^- radicals is also observed, which apparently is also responsible for the emission. The emission in the region of 270–310°K does not terminate with melting of the acid. This behavior is explained by chemiluminescent reactions of stable radiolysis products. It is shown that dissolution of UO_2^{++} and quinine in the acid does not lead to an increase in Tl intensity, although the intensity of photoluminescence increases in this case by a number of orders of magnitude. The spectral region of Tl emission is close to the photoluminescence in uranyl solutions, and differs considerably for quinine solutions. (SJR)

6077 KINETICS OF THE DISSOLUTION OF IONIC CRYSTALS IRRADIATED BY FAST ELECTRONS. Parkhaeva, T. N.; Gromov, V. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 8, 1118-1121(Aug 1973).

Translated from Zh. Fiz. Khim.; 47: No. 8, 1987-1990(Aug 1973).

The rate constant k_r for the dissolution of irradiated ionic crystals depends upon the concentration and nature of the radiation defects. Thus F- and M-centers increase the rate of dissolution while (X^0_{2g}) centers, arising as the electron defects are disrupted, tend to decrease it. (auth)

6078 PROCESS FOR PREPARING WOOD PLASTIC MATERIALS. Bell, B. V. (to Atlantic Richfield Co.). Canadian Patent 930,295. 17 Jul 1973.

Hard impregnated wood tiles or panels, suitable for parquet floors, are made from strips or fillets, which are fastened together (with staples, by gluing to a backing sheet, etc.) impregnated with a monomer, and irradiated with gamma rays. The wood is preferably red oak, the monomer methyl methacrylate, and the irradiation facility is preferably of the pool type. (CA)

6079 COMPOSITION OF UNSATURATED POLYESTERS RESINS. Ogino, A.; Ikumura, Y.; Fuzioka, S. (to Takeda Chemical Industries, Ltd.). Japanese Patent 1973,2422. 1 Jul 1969. 8p. (In Japanese).

An appropriate composition of the constituents of the polyesters was found for obtaining a hard non-viscous membrane, which was insoluble to the solvents as a coating material. Polyesterification was carried out following a known method with the mixture of (1) unsaturated dicarboxylic acids (25-50 mole %), (2) glycols mainly consisting of ethylene glycol, and (3) polyalcohols of drying oils. The polyester products were dissolved in the monomer solvent such as styrene and vinyl toluene, and then irradiated by electron beams with the dose of 2 Mrad. The present method reduced the required amount of the dose and consequently the irradiation time compared with the conventional ones. Addition of other materials such as paints does not affect the effectiveness of the present method. (JA)

6080 SURFACE ACTIVITY OF ZINC OXIDE. Examination of the Effect of γ-Irradiation by Electron Spin Resonance, Electrical Conductivity, Reflectance Spectroscopy, and Gas Adsorption. Duck, M. J.; Nelson, R. L. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Chem. Soc., Faraday Trans., I; 70: No. 3, 436-449(1974).

From Faraday meeting on the role of surface charge in reactions at interfaces; Cork, Ireland (Jan 1973).

The activity of the n-type semiconductor zinc oxide is considerably affected by γ-irradiation. Studies have been conducted both on powders which are in an "excess zinc" condition as a result of evacuation at high temperatures and on powders which are close to stoichiometry. In non-stoichiometric zinc oxide the surface activity is dominated by the presence of donor sites and their associated electrons, which are distributed throughout the bulk of the crystallites, and changes in the concentration of these have been monitored by ESR, reflectance spectroscopy, and electrical conductivity measurements. In more stoichiometric zinc oxide the surface activity is lower, but can be stimulated to a greater relative extent by γ-irradiation. The radiation-induced electrical conductivity and the lifetime of the "free" electrons in the conduction band are critically dependent on the surface conditions; adsorbed water acts as an efficient electron-hole recombination center, oxygen as an electron trap, and hydrogen as a hole trap. Whereas chemically produced non-stoichiometry is associated with donor sites having electrons in levels high in the forbidden gap, the F^+ center point defect which is produced by lattice displacements as a result of elastic collisions appears to possess electrons in low-energy levels within the forbidden gap. (auth)

6081 RADICALS PF_4 AND PF_5^-. Mishra, S. P.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Chem. Commun.; No. 7, 279-280(3 Apr 1974).

It is shown by ESR spectroscopy that a radical in γ-irradiated NH_4PF_6 and KPF_6, previously identified as PF_4, is in fact PF_5^-. (auth)

6082 RADIATION POLYMERISATION OF ACRYLIC ACID IN SOLUTION IN ISOPROPANOL AND DIMETHYLFORMAMIDE. Chapiro, A.; Perec, L.; Russo, S. (CNRS, Meudon-Bellevue, France). Eur. Polym. J.; 10: No. 1, 71-73(Jan 1974). (In French).

The radioinduced polymerization of acrylic acid in isopropyl alcohol and dimethylformamide solutions was investigated between -196 and 40°C using a ^{60}Co source of 1700 rad/min for the low temperatures and 12 rad/min for the room temperature investigations. Mixtures that form glasses at low temperatures exhibit a maximum in the rate of polymerization at 30 and 50°C above the glass transition temperature (T_g). The difference between the most favorable temperature for polymerization and T_g is larger than in systems studied previously. The fact could be due to the presence of H-bonded aggregates. The study of the polymerization of acrylic acid in dimethylformamide solution at 20°C led to a correlation between this reaction and the presence of plurimolecular aggregates. The very high polymerization rate and the syndiotacticity of the resulting poly(acrylic acid) confirm the earlier assumption of a favorable orientation for propagation of the molecules of acrylic acid in these aggregates. (auth)

6083 PULSE RADIOLYSIS STUDY OF THE KINETICS OF ELECTRON REACTIONS IN LIQUID N-HEXANE AT ROOM TEMPERATURE. Baxendale, J. H.; Rasburn, E. J. (Univ. of Manchester, Eng.). J. Chem. Soc., Faraday Trans., I; No. 4, 705-717(1974).

The behavior of solvated electrons, e^-_s, produced by the pulse radiolysis of n-hexane at 20°C was followed using optical absorption techniques. Rate constants for the reaction of e^-_s with naphthalene, biphenyl, galvinoxyl, chloroform, carbon tetrachloride, perfluoromethylcyclohexane, carbon dioxide, nitrous oxide, and oxygen were determined and are in the range 0.1 to 1.8×10^{12} $dm^3\ mol^{-1}\ s^{-1}$. The rate constant, k_r, for the recombination of e^-_s with solvent cations was redetermined. If $G(e^-_s) = 0.13$ then $k_r = 7.1\ (\pm 0.8) \times 10^{13}\ dm^3\ mol^{-1}\ s^{-1}$. The changes in the absorption spectrum of e^-_s, which occur on the addition of alcohols and water were investigated and the variations in mobility of e^-_s that accompany these changes were measured by observing e^- reaction rates in the mixtures. The mechanism of solvation by alcohol is discussed and it is concluded that it occurs by electron diffusion to already formed clusters of alcohol rather than by aggregation of alcohol around the electron. (auth)

6084 CONDUCTIMETRIC STUDY OF THE KINETICS OF ELECTRONS IN PULSE IRRADIATED N-HEXANE AND CYCLOHEXANE AT ROOM TEMPERATURE. Baxendale, J. H.; Keene, J. P.; Rasburn, E. J. (Univ. of Manchester, Eng.). J. Chem. Soc., Faraday Trans., I; No. 4, 718-728(1974).

Measurements of the ion current following an electron pulse have given values of k_r/μ (where k_r is the ion recombination rate constant and μ the electron mobility) and $G\mu$ (extrapolated to zero field) of $1.00\ (\pm 0.08) \times 10^{-4}$ V cm and $1.13\ (\pm 0.05) \times 10^{-2}\ cm^2\ V^{-1}$ respectively for n-hexane, and $0.91\ (\pm 0.07) \times 10^{-4}$ V cm and $5.0\ (\pm 0.3) \times 10^{-2}\ cm^2\ V^{-1}$ for cyclohexane. For n-hexane these and results obtained optically are consistent with $k_r = 6\ (\pm 1) \times 10^{13}\ dm^3\ mol^{-1}\ s^{-1}$, $G = 0.13$ and $\mu = 0.09\ cm^2\ V^{-1}\ s^{-1}$. Using $\mu = 0.35\ cm^2\ V^{-1}$ for cyclohexane, $k_r = 1.93\ (\pm 0.14) \times 10^{14}\ dm^3\ mol^{-1}\ s^{-1}$. Rate constants for reaction of solutes with electrons in n-hexane have been measured which confirm those obtained optically. For electron reactions in cyclohexane $k(e^- + S) \times 10^{-11}\ dm^3\ mol^{-1}\ s^{-1}$ are 1.70, 43, 43, 33, 66, 90 and 3.5 when S is O_2, CO_2, CCl_4, Ph_2, diphenylanthracene, galvinoxyl and perfluoromethylcyclohexane respectively. The mobility of the electron in n-hexane + alcohol mixtures is found to be unaffected until the alcohol concentration approaches 30 mol dm^{-3} and at these low concentrations the electron reacts with the alcohol. (auth)

6085 NON-FOSSIL FUEL PROCESS FOR PRODUCTION OF HYDROGEN AND OXYGEN. von Fredersdorff, C. G. (to Institute of Gas Technology). US Patent 3,802,993. 9 Apr 1974. Filed date 27 Dec 1971. 12p.

A method is reported for hydrogen and oxygen production by fissiochemical decomposition of carbon dioxide. Carbon monoxide and oxygen are produced, followed by subsequent separation of the oxygen from the carbon monoxide, and production of hydrogen by the action of steam on iron at elevated temperatures, which is followed by regeneration of the product iron oxide by carbon monoxide as separated from the fissiochemical decomposition products issuing from the nuclear reactor. The oxygen may be separated from the fissiochemical decomposition products by the formation of metal oxides by reaction with reactive metals such as iron, chromium, manganese, and mercury. The process also employs steps for preventing build-up of oxygen concentrations to explosive levels, steps for recovery of radioisotopes, and the generation of steam. (Official Gazette)

6086 FREE RADICALS. Volume I. Reactive Intermediates in Organic Chemistry. Kochi, J. K. (Ed.). New York; John Wiley and Sons, Inc. (1973). 728p.

Topics considered are: rate processes in the gas phase; rate constants for free radical reactions in solution; decompositions of peroxides and azoalkanes; "cage effects"; diradicals; a case study of trimethylene; chemically induced dynamic nuclear polarization; reactivity, selectivity, and polar effects in hydrogen atom transfer reactions; free radical rearrangements; electron transfer reactions of organic anions; bimolecular homolytic

substitution at metal centers; oxidation-reduction reactions of free radicals and metal complexes; homogeneous liquid-phase autoxidations; addition to multiple bonds; atom-transfer and substitution reactions; halogenation; aromatic substitution; thermochemistry of free radicals; structure and stereochemistry of free radicals; structure of free radicals by ESR spectroscopy; nitrogen-centered radicals; phosphorus radicals; oxygen radicals; sulfur-centered radicals; Group IVB radicals; and bridged free radicals. (LK)

6087 REVIEW OF PROPERTIES OF POLYCARBONATE RESINS. Kazanjian, A. R. (Dow Chemical, Golden, CO). Contract AT(29-1)-1106. Polym.-Plast. Technol. Eng.; 2: No. 2, 123-160(1973). (RFP-1884).

The mechanical, thermal, electrical and chemical properties of poly(4,4-dioxydiphenyl-2,2-propane carbonate) are reviewed. Radiation stability, thermal stability, flammability, and gas permeability are also considered. (LK)

6088 THERMAL AND RADIATION STABILITY OF THE ORGANIC COOLANT BASED ON ISOPROPYLDIPHENYL AND ITS INFLUENCE ON CORROSION OF CONSTRUCTION MATERIALS. Burclova, J.; Varadinova, A. (Atomova Elektrarna, Jaslovske Bohunice, Czech.). Jad. Energ.; 20: No. 2, 56-59 (1974). (In Czech).

The thermal and radiation stability of the organic coolant based on monoisopropyldiphenyl was studied by testing its viscosity and density. The influence of temperature, magnitude of dose of gamma radiation, and sensitivity of a coolant to presences of impurities was studied. During a radiation experiment, gases arising from the radiolysis were analyzed and their quantity was measured in a dependence on dose of gamma radiation. Corrosion processes on a surface of the Mg/2Be alloy were studied as functions of temperature, dose of gamma radiation, and quantity of impurities in a coolant. Some experiments were also performed with the Zr–Mo–Cu alloy and with a coolant from the Soviet production Dauterm (a mixture of a diphenyl and diphenylether). (auth)

6089 DECOMPOSITION OF NITROUS OXIDE IN THE RADIOLYSIS OF N-HEXANE SOLUTIONS. Hatano, Y.; Abboud, J. L. (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 47: No. 1, 236-237(Jan 1974).

The effect of the addition of N_2O (10^{-3}–10^{-1} mole fraction) in the γ-radiolysis of liquid n-hexane has been examined. The oxygen-containing products such as water and alcohols have been detected. The number of nitrogen molecules produced per an electron scavenged by N_2O exceeds unity even at the lowest concentration. (auth)

6090 ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED SUCCINAMIC ACID. I. TRICLINIC SINGLE CRYSTALS. Straw, D.C.; Moulton, G.C. (Physics Department, Florida State University, Tallahassee, Florida 32306). J. Chem. Phys. 60: No. 4, 1223-1230 (15 Feb 1974).

The products formed by x-irradiation of single crystals of triclinic succinamic acid have been studied by electron spin resonance in the temperature range from 77° to 300°K. The primary product observed at 77°K is the oxidation radical, $CONH_2CH_2\dot{C}H_2$, (I), formed by decarboxylation. The two α-hydrogens in I are exchanging rapidly and are equivalent at all orientations. Radical I decays by either an intermolecular or an intramolecular process to give two other products, $CONH_2CH_2CHCOOH$ (II) or $CONH_2\dot{C}HCH_3$ (III), respectively. Both II and III are stable at room temperature, however, III predominates in crystals irradiated at 300°K, whereas II predominates in crystals irradiated at 77°K and warmed to 300°K. (auth)

6091 ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED SUCCINAMIC ACID. II. MONOCLINIC SINGLE CRYSTALS. Straw, D.C.; Moulton, G.C. (Department of Physics, Florida State University, Tallahassee, Florida 32306). J. Chem. Phys. 60: No. 4, 1231-1235 (15 Feb 1974).

The radiation products and decay mechanisms have been studied in single crystals of monoclinic succinamic acid using electron spin resonance spectroscopy over the temperature range from 77° through 300°K. At 77°K the primary radical observed is the anion radical $COOHCH_2\dot{C}H(CONH_2)^-$ where the unpaired electron is delocalized throughout the entire amide group. This radical decays at about 180°K to a nonparamagnetic species. The minor product at 77°K is the cation product and decays at about 157°K by intermolecular hydrogen abstraction to two radicals which are stable at room temperature, $COOHCHCH_2CONH_2$, and $COOHCH_2CHCONH_2$. The spectra observed at 300°K are identical in crystals irradiated at 77°K and warmed to 300°K. The differences in the radiation products and mechanisms for the monoclinic and triclinic forms are discussed. (auth)

6092 FORMATION OF EXCITED STATES AND IONS IN THE RADIOLYSIS OF BENZYL ALCOHOL. Kira, A.; Thomas, J.K. (Department of Chemistry and the Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 60: No. 3, 766-771 (1 Feb 1974).

Transient species in benzyl alcohol and solutions of benzyl alcohol were studied by means of the nanosecond pulse radiolysis technique. Neat benzyl alcohol gives a benzyl radical with G = 2.1 which is produced by dissociative electron attachment. In solutions of lithium iodide, I_2^- with a G = 2.1 is observed; however, the yield of the solvent cation measured by using t-stilbene is only 0.2. It is suggested that a radical $BzCH_2O\cdot$ resulting from an ion–molecule reaction of the primary solvent cations and solvent molecules is a probable precursor of I_2^-; therefore G = 2.1 refers to the cation yield. The yield for the excited singlet and triplet states, 0.70 ± 0.10 and 1.10 ± 0.10 were determined using solutes such as 1,1'-binaphthyl, 1,2-benzanthracene, pyrene, naphthalene, and benzophenone. The interplay of ionization and direct excitation in the formation of excited states are discussed. (auth)

6093 MATRIX PROTON ENDOR STUDIES OF THE OVERLAP OF TRAPPED ELECTRON WAVEFUNCTIONS WITH FIRST SOLVATION SHELL MOLECULES IN METHANOL GLASS AT 77 K. Schwartz, R.N. (Department of Chemistry, University of Illinois at Chicago Circle, Chicago, Illinois 60680); Bowman, M.K.; Kevan, L. J. Chem. Phys. 60: No. 4, 1690-1691 (15 Feb 1974).

The matrix proton ENDOR linewidths of trapped electrons in γ-irradiated CH_3OH, CH_3OD, and CD_3OH glasses at 77 K have been measured and analyzed. The order of observed ENDOR linewidths, $CD_3OH < CH_3OD \simeq CH_3OH$, which contrasts with the order of EPR linewidths, $CH_3OD < CD_3OH \leq CH_3OH$, is shown to support a model in which the trapped electron wavefunction is largely localized over the O–H bonds of its first solvation shell molecules. (AIP)

6094 INFLUENCE OF γ-RADIATION ON THE THERMAL CONDUCTIVITY AND DENSITY OF SOME POLYMERS. Bondarev, V. D.; Briskman, B. A.; Sabina, V. P. Plast. Massy; 7: 7-10(1973).

A study was made of the relationship of the thermal conductivity coefficient λ and the density ρ to temperature and γ-radiation for both crystalline polymers (polyethylene and fluorlon-4) and amorphous polymers (polystyrene and polymethylmetacrylate). For polyethylene at 30°C λ decreased by 40% and at 150°C it increased by 36% for rather low levels of radiation; it did not change for doses in the range 2000–3100 millirads. The density increased only 1.2%. For fluorlon-4 λ did not change significantly with temperature. The value of λ decreased slightly with irradiation. The behavior of ρ was a function of the crystallinity. For polystyrene λ increased by 24% in the temperature range 16 to 85°C and practically did not change with irradiation. For polymethylmetacrylate, λ increased by about 25% in the temperature range 18 to 98°C and practically did not change with irradiation. Possible reasons and implications of these values are discussed. (JPRS)

6095 INFLUENCE OF γ-RADIATION ON THE PHYSICAL MECHANICAL PROPERTIES OF POLYETHYLENE AND POLYCARBONATE. Vinogradshaya, E. L.; Agamalyan, S. C.; Vdovina, A. L. Plast. Massy; 7: 10-12(1973). (In Russian).

A study was made of the influence of γ-radiation on the molecular structure of high density polyethylene (HDPE) and polycarbonate (PC). Increasing the dose to 25 millirads resulted in an increase in the stability limit during stretching for HDPE; increasing the dose from 25 to 200 milli-rads resulted in a decrease in σ_y. Density, module of elasticity, hardness, and fatigue stability for HDPE in general increased with increasing dose. The molecular weight and fatigue resistance decreased for PC. Values for other parameters are given. The radiation of HDPE results in "linking" processes and leads to the breakdown of spherulite formation, and to the breakup and subsequent compaction of the structural elements. In PC, however, irradiation results in destructive processes leading to the fragmentation of the polymers. (JPRS)

6096 INFLUENCE OF ACCEPTON-DONOR IMPURITIES DURING IRRADIATION ON THE ELECTRICAL CONDUCTIVITY OF POLYVINYLCHLORIDE. Sichkar, V. P.; Vaysberg, S. E. Plast. Massy; 7: 5-7(1973). (In Russian).

A study was made of the relationship of the electrical conductivity (σ) to the dose (I) of γ-radiation from a ^{60}Co source for poly(vinyl chloride) (PVC) containing acceptor impurities (duroquinone, chloranil, and tetracyanodimethane) and donor impurities (tritoluene amine). The impurities (0.2 to 0.9 mol %) did not exert a significant influence on either σ or on the exponent Δ in the equation $\sigma \alpha I^{\Delta}$. The conductivity $\sigma \times 10^{-15}$ $ohm^{-1} \cdot cm^{-1}$ varied from 3.5 for a Δ of 0.88 to 6.6 for a Δ of 0.92 (the maximum Δ was 1.00). The concentration (p) of the carrier current in the conducting zone can be expressed as $p = N_c e^{E_f/kT}$ where $N_c = 10^{19}$ cm^{-1} is the effective density of the compound near the bottom of the conducting zone and E_f is the depth of the Fermi quasiplane which changes with T and I. Some values obtained

were $p = 10^3$ cm^{-1} and 10^2 cm^{-1} for E = 0.6 eV and 0.8 eV respectively. Using $\sigma = pq\mu$, $\mu = 10^{-4}$ cm^2/volt · sec and 10^{-1} cm^2/volt · sec for the above values of E. (JPRS)

6097 RADIATION STABILITY OF ETHYLENE AND STYRENE COPOLYMERS. Terteryan, R. A.; Leshchenko, S. S.; Livshits, S. D.; Golosov, A. P.; Itsikson, L. B.; Monastyrskii, V. N.; Karpov, V. L.; Soboleva, N. S.; Mal'tseva, A. P.; Iskhakov, L. I. Plast. Massy; 7: 3-5(1973). (In Russian).

A study was made of the continuous statistical copolymerization of ethylene monomers (E) with styrene (S) under conditions similar to those under which low density polyethylene is produced and also of the behavior of E + S polymers in an ionizing radiation field. The results of copolymerization studied, grams of copolymer/hr concentration of S in the polymer, density, and others, are given as a function of styrene concentration and pressure at 200°C. An increase in the concentration of S in the reaction mixture leads to a decrease in the copolymer yield, in its characteristic viscosity, in its melting temperature, and its crystallinity, and to an increase in the density. The presence of S monomers in the polyethylene chains and the chemical bonds between them and the methylene groups significantly increases the resistance of the material to α-radiation damage. The gases evolved during the radiation of various types of polymers were determined. (JPRS)

6098 ULTRAVIOLET- AND γ-RAY INDUCED REACTIONS OF NUCLEIC ACID CONSTITUENTS: REACTIONS OF PURINES WITH ETHERS AND DIOXOLANE. Leonov, D.; Elad, D. (Weizmann Inst. of Science, Rehovot, Israel). J. Org. Chem.; 39: No. 11, 1470-1473(31 May 1974).

Ultraviolet- and γ-induced reactions of caffeine, adenine, and guanosine with tetrahydrofuran, tetrahydropyran, dioxane, tetrahydrofurfuryl alcohol, and dioxolane are described. The reactions lead to the appropriate 8-substituted purines in yields of up to 90% when performed in the presence of photoinitiators. A free-radical mechanism is proposed for these reactions. (auth)

6099 NUMBER OF ATOMS FORMED PER ION PAIR IN TRITIUM GAS. CORRELATION WITH MOLECULAR PROCESSES. Jones, W.M.; Dever, D.F. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Chem. Phys. 60: No. 7, 2900-2906 (1 Apr 1974).

The number of atoms formed per ion pair by the β particles in tritium gas was determined to be $M_0 = 5.1 \pm 0.3$ by capture of the atoms on a surface of molybdenum trioxide at 22, 40, 60, and 100°C and from 8 to 211 torr. Correction was made for a decrease in the measured number of atoms per ion pair with increasing pressure. The effect was interpreted as resulting from a competition between capture of atoms by MoO_3 and surface recombination, with the former dominating at low pressure. Atoms are formed by $T_2^+ + T_2 \rightarrow T_3^+ + T$ (R1) and $T_3^+ + e^- \rightarrow T_2 + T$ (R2), by $T_3^+ + e^- \rightarrow 3T$ (R2') to at most a minor extent, and by excitation of triplet and subsequently quenched singlet molecular states. The number of atoms resulting from dissociative recombination of H_3^+ (n_r) was found to be approximately one by reconsidering the conditions of an experiment of Corrigan. This value of n_r and previous calculations of the numbers of triplet and singlet excitations per ion pair were used to deduce $M_0 = 4.8$, in reasonable agreement with experiment. (auth)

6100 ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED CADMIUM FORMATE DIHYDRATE AND MANGANESE(II) IONS IN CADMIUM FORMATE DIHYDRATE. Booth, R.J.; Herring, F.G. (Department of Chemistry, The University of British Columbia, Vancouver, British Columbia, Canada, V6T 1W5). J. Chem. Phys. 60: No. 7, 2773-2778 (1 Apr 1974).

ESR spectra of radiation induced Cd^+ ions have been observed in monoclinic $Cd(HCO_2)_2 \cdot 2H_2O$ at 77 K. A single-crystal study showed that there is a preferred capture by Cd^{2+} ions occupying the more asymmetric of the two cation sites. A comparative study of Mn^{2+} ions, substitutionally introduced into $Cd(HCO_2)_2 \cdot 2H_2O$, carried out at room temperature confirmed this result. The Mn^{2+} ions showed no preference for either of the sites. The results indicate that there is little distortion of the crystal structure on cooling or when the electron excess center is produced. (auth)

6101 VOLATILIZATION OF FISSION PRODUCTS FROM SOLID URANIUM(IV) FLUORIDE AND OTHER FLUORIDES. Weber, M.; Trautmann, N.; Menke, H.; Herrmann, G.; Kaffrell, N. (Univ., Mainz). Radiochim. Acta; 19: No. 3, 106-113(1973). (In German).

The volatilization of fission products from neutron-irradiated UF_4 in an argon stream was investigated. A total of 12 elements (Se, Kr, Zr, Nb, Mo, Tc, Ru, Sn, Sb, Te, I, Xe) were observed in the volatile part. The volatile mixture was separated by fractional condensation in a tube having a temperature gradient. For some elements, the influence of various parameters such as temperature and duration of the volatilization, carrier gas pressure and target thickness was investigated. At a volatilization temperature of 800°C, yields between 70% and 95% were obtained. The rates of volatilization can be characterized by half-times lying between 5 and 15 seconds. In addition to UF_4, other substances were investigated to determine their utility as target materials. These were ThF_4 and mixtures consisting of U_3O_8 or $^{235}UO_2$ combined with one of the following compounds: KF, MgF_2, CaF_2, SrF_2, AlF_3, YF_3, and K_2TiF_6. (GE)

6102 CHEMICALLY INDUCED DYNAMIC ELECTRON POLARIZATION. V. A POSSIBLE THEORY FOR ALKYL RADICALS PRODUCED IN RADIOLYSES. Wong, S.K.; Hutchinson, D.A.; Wan, J.K.S. (Department of Chemistry, Queen's University, Kingston, Ontario, Canada). J. Chem. Phys. 60: No. 8, 2987-2990 (15 Apr 1974).

This work describes the spontaneous emission and enhanced absorption pattern of the initial spin polarization of alkyl radicals, XH_2 and XH_3, produced in radiolyses. It is assumed that the various total spin multiplets (electron and nuclear) have different probabilities of formation; this is an extension of our earlier work on the H and D atoms. The mode—spontaneous emission or enhanced absorption—for a given ESR line depends on two factors: first, which total spin multiplet is the more probable and second the sign of the isotropic hyperfine splitting constant. (auth)

6103 PROTON TRANSFER IN IRRADIATED L-CYSTEIC ACID MONOHYDRATE. Box, H.C.; Budzinski, E.E. (Biophysics Department, Roswell Park Memorial Institute, Buffalo, New York 14203). J. Chem. Phys. 60: No. 8, 3337-3338 (15 Apr 1974).

The protonation of the reduced species in x-irradiated single crystals of cysteic acid monohydrate has been studied by ESR and ENDOR spectroscopy. (AIP)

6104 FREE RADICALS IN IRRADIATED METHYL CYTOSINE. Rustgi, S.N.; Box, H.C. (Physics Department, State University of New York at Buffalo, Buffalo, New York 14214). J. Chem. Phys. 60: No. 8, 3343-3344 (15 Apr 1974).

The ESR and ENDOR spectra of irradiated methyl cytosine were obtained. Three different radical species were identified and the principal values of the hyperfine coupling tensors were obtained for each radical. (AIP)

Radiochemistry and Nuclear Chemistry

6105 (TID-3345) RADIUM: A BIBLIOGRAPHY. (USAEC Technical Information Center, Oak Ridge, Tenn.). May 1974. 635p. Dep. NTIS $13.60.

This bibliography contains 3235 references taken from Nuclear Science Abstracts covering the period 1950–1973. Abstracts and a subject index are included. Also included in its entirety is an earlier bibliography (TID-363) covering the period 1898 through 1949. (JGB)

Hot-Atom Chemistry

6106 POST-EFFECTS OF ISOMERIC TRANSITION FOR MOESSBAUER TIN ATOMS HELD ON ION-EXCHANGE RESIN. Ablesimov, N. E.; Bondarevskii, S. I. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 472-474(1973).

Translated from Radiokhimiya; 15: No. 3, 465-466(1973).

The Moessbauer effect was used to investigate the after-effect of a converted isomeric transition for tin atoms sorbed on an ion-exchange resin (AV-16). The Moessbauer atoms were held on the surface of a solid (by ion exchange) which made it possible to bring them into contact with gas, liquid, and frozen liquid. (LK)

6107 REACTIONS OF RECOILING SILICON ATOMS WITH PHOSPHINE AND BUTADIENE, AND THE ADDITION OF SILYLENE TO BUTADIENE. Gasper, P. P.; Kwang, R. J.; Eckelman, W. C. (Washington Univ., St. Louis). J. Chem. Soc., Chem. Commun.; No. 7, 242-243(3 Apr 1974).

Silicon atoms recoiling from the $^{31}P(n,p)^{31}Si$ nuclear transformation in gaseous mixtures of phosphine and buta-1,3-diene give a low yield of [^{31}Si]-1-silacyclopent-3-ene and a $^{31}SiC_4H_8$ compound believed to be [^{31}Si]-1-silacyclopenta-2,4-diene; the formation of some silylene from phosphine is indicated, and silylene is found to add in high yield to butadiene. (auth)

6108 REACTIONS OF ENERGETIC HYDROGEN ATOMS WITH SIMPLE HYDROCARBONS. III. Bromine Scavenge Effects. Hall, R. B.; Malcolme-Lawes, D. J. (Brown Univ., Providence, RI). J. Chem. Soc., Faraday Trans., I; No. 4, 648-654(1974).

The effect of small amounts of bromine on the hot abstraction and substitution yields from recoil tritium atoms reacting with

methane are examined in the presence of neon, argon and xenon. It is concluded that bromine reduces the yield of both products by competing with the hydrocarbon for the hot atoms, and that the moderator influences the magnitude of the excitation function for HT production (through collisional dissociation of excited HT) so that the scavenger effect becomes more pronounced in the order Ne < Ar < Xe moderator. (auth)

6109 HOT HYDROGEN ATOMS: INITIATORS OF REACTIONS OF INTEREST IN INTERSTELLAR CHEMISTRY AND EVOLUTION. Hong, K. Y.; Hong, J. H.; Becker, R. S. (Univ. of Houston, TX). Science; 184: No. 4140, 984-987(31 May 1974).

Photochemically generated hot hydrogen atoms initiate reactions with simple molecular substrates including methane to produce organic alcohols, amines, acids, amino acids, and other compounds The typical quantum yields for the formation of amino acids are 2×10^{-5} to 4×10^{-5}. Hot hydrogen atoms may be important initiators of reactions in interstellar space and in planetary atmospheres. (auth)

6110 REACTIONS OF ^{130}I ACTIVATED BY RADIATIVE NEUTRON CAPTURE AND ISOMERIC TRANSITION IN GASEOUS CH_4 AND CD_4. Nicholas, J. B.; Yoong, M.; Rack, E. P. (Univ. of Nebraska, Lincoln). Radiochim. Acta; 19: No. 3, 124-128(1973).

The reactions of (n,γ)-activated and (I.T.)-induced ^{130}I in gaseous CH_4 and CD_4 were determined and discussed. The results suggested that the reactions of ^{130}I were complex involving not only iodine atoms or ions possessing excess kinetic energy but also translationally thermalized and electronically excited iodine ions in $^1D_2$, $^3P_0$, and $^3P_1$ states. The hot organic yields of (n,γ)-activated $^{130}I + {}^{130m}I$ were consistently higher than (I.T.)-activated ^{130}I yields in the gaseous system studied. This may suggest that (n,γ)-activated $^{130}I + {}^{130m}I$ hot reactions occur predominantly as the result of kinetic energy imparted to the recoil iodine atoms or ions following gamma-ray cascades while the isomeric transition induced hot reactions which have lower organic yields occur predominantly as a result of kinetic energy acquired following coulombic repulsions. (GE)

6111 THEORETICAL INVESTIGATIONS OF THE REACTION DYNAMICS OF POLYATOMIC SYSTEMS: CHEMISTRY OF THE HOT ATOM (T^*+CH_4) AND (T^*+CD_4) SYSTEMS. Raff, L.M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). J. Chem. Phys. 60: No. 6, 2220-2244 (15 Mar 1974).

An unadjusted computation of the reaction dynamics in the (CH_4+T^*) and (CD_4+T^*) systems has been carried out. The six-body potential-energy surface has been obtained from the equilibrium thermodynamic and spectroscopic data for reactants and products, the results of all-valence electron INDO and all-electron, ab initio SCF and CI quantum calculations, and previously formulated three- and four-body valence-bond (VB) potential surfaces. The computed saddle-point geometries for axial abstraction and inversion displacement are in good to excellent agreement with previous ab initio CI calculations. The saddle-point energies are in fair to good agreement. Computed fundamental vibration frequencies for CH_4 are in excellent accord with ir and Raman data. Reaction cross sections as a function of relative translational energy for abstraction, displacement, and fragmentation in (CH_4+T^*) and (CD_4+T^*) systems have been computed by quasiclassical trajectory analysis. Calculated thresholds are in quantitative agreement with experiment. The abstraction and displacement reaction dynamics are examined and discussed. Hot-atom yield ratios in both systems have been determined through solutions of the integral reaction probability equation. Computed results for nuclear recoil tritium incident upon CH_4 are in quantitative agreement with experiment. Yield ratios for [CD_3T/DT] obtained by photolysis of TBr are in excellent accord with experiment at all photolysis energies. Abstraction yields in CH_4 are computed and found to be in good agreement with experiment. The low energy (40-65 kcal/mole) displacement cross sections are found to be too low by a factor of 2-3. (auth)

6112 ON THE UNIMOLECULAR ISOMERIZATION OF METHYL ISOCYANIDE AFTER HOT TRITIUM SUBSTITUTION. Steed, C.J.; Harris, H.H. (Department of Chemistry, University of Missouri-St. Louis, St. Louis, Missouri 63121). J. Chem. Phys. 60: No. 4, 1355-1357 (15 Feb 1974).

The Bunker formulation of RRKM theory is used to investigate the yields of CH_2TCN and CH_2TNC after the substitution of tritium for hydrogen on methyl isocyanide. To rationalize experimental data, large amounts of rotational energy are required at the last collision where either the rate coefficients for the forward and reverse reactions are comparable to the mean free time. This would imply either that the substitution reaction produces even larger amounts of rotational excitation than was previously expected (by typically occurring at larger impact parameters) or that rotational energy is not transferred to collision partners as effectively as in collisions near thermal energy. (auth)

6113 ^{51}Cr-LABELLED SPECIES IN NEUTRON-IRRADIATED TRISACETYLACETONATOCHROMIUM(III). Omori, T.; Shiokawa, T. (Tohoku Univ., Sendai). Radiochem. Radioanal. Lett.; 17: No. 3, 167-176(6 May 1974).

A newly developed column chromatography exhibited the existence of various ^{51}Cr-labelled species including cis-bisacetylacetonatochromium(III) and monoacetylacetonatochromium(III) in the neutron-irradiated trisacetylacetonatochromium(III). Reformation reaction mechanisms in both the solid and the organic solution of the irradiated target are compared. A method for the preparation of the complexes with two different ligands is also proposed. (auth)

6114 SZILARD-CHALMERS REACTION IN ETHYL IODIDE IRRADIATED WITH A GAMMA-FREE THERMAL NEUTRON BEAM. de Hater, M. E.; Cruset, A. (Instituto Nacional de Energia Nuclear, Mexico City). Radiochem. Radioanal. Lett.; 17: No. 3, 163-166(6 May 1974).

Szilard-Chalmers reaction in ethyl iodide irradiated either with a gamma-free thermal neutron beam, or in a reactor at low fluxes, yields the same value for total organic retention. (auth)

6115 REACTIONS OF ^{123}I ATOMS WITH BENZENE AND DEUTEROBENZENE IN LIQUID PHASE. Vernois, J.; Arapaki-Strapelias, H.; Muxart, R. (Univ., Paris). Radiochem. Radioanal. Lett.; 17: No. 3, 145-154(6 May 1974). (In French).

The reactions of nucleogenic ^{123}I atoms with C_6H_6 and C_6D_6 in the liquid phase were studied. The total organic yield of ^{123}I and the yields of $^{123}IC_6H_5$ and $^{123}IC_6D_5$ were measured. The results show an important isotopic effect which favors the reaction of ^{123}I with C_6H_6. The total organic yields for C_6H_6 and C_6D_6 are 40 and 30% respectively in the absence of scavenger and 13 and 7% in the presence of 10^{-3} m.f. of I_2. The yields of $^{123}IC_6H_5$ and $^{123}IC_6D_5$ are 10 and 5% respectively and are not affected by the presence of iodine up to 10^{-3} m.f. (auth)

Properties of Radioactive Materials

Refer also to abstracts 6007, 7181, 7192, and 7470.

6116 (BARC/I-135, pp 33-40) INFRARED AND NMR STUDIES ON COMPLEXES OF URANYL-β-DIKETONES WITH PYRIDINE-N-OXIDES. Subramanian, M. S.; Manchanda, V. K. (Bhabha Atomic Research Centre, Bombay). 1971.

Characteristic infrared (sodium chloride and cesium bromide regions) stretching frequencies and proton magnetic resonance spectra of complexes of uranyl β-diketonates with 4Z pyridine-N-oxides (where Z = CH_3 or Cl or NO_2) have been studied. The β-diketones used in the studies are thenoyltrifluoroacetone (TTA), benzoyl-trifluoroacetone (BTFA), benzoylacetone (BA), dibenzylmethane (DBM), trifluoroacetylacetone (TFAA) and hexafluoroacetyl acetone (HFAA). For each complex, O-U-O asymmetric stretching frequency, N-O stretching frequency and carbonyl stretching frequency are determined. In proton magnetic resonance studies, chemical shift data for ring proton (H_b and H_a) in the free ligands as well as in complexes (H'_b and H'_a) are determined. An attempt has been made to correlate the observed spectra with the substituent parameter (σ^+). (INIS)

6117 (CNEA-334) PREPARATION OF THE DICARBOXYLIC SUCCINIC, GLUTARIC, AND ADIPIC ACIDS LABELLED WITH ^{14}C IN THE CARBOXYL. Arciprete, J. A.; Correis, R. J.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Feb 1973. 8p. (In Spanish). INIS.

The dicarboxylic succinic, glutaric, and adipic acids labelled with ^{14}C in the carboxyl were prepared from ^{14}CNK. The method includes the following steps: (a) preparation of the nitriles by means of the reaction of the alkyl dihalides with ^{14}CNK; (b) hydrolysis of the nitriles with HCl concentrate. The labelled acids were controlled by paper and thin layer chromatography. (auth)

6118 (ETR-269) DECONTAMINATION OF HIGHLY ACTIVE PROCESS EQUIPMENT OF THE EUROCHEMIC REPROCESSING PLANT. van Geel, J.; Centeno, J.; Gustafsson, B.; Heinz, W. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Apr 1971. 46p. INIS.

After 4 years of active reprocessing nuclear fuel of different origin and specific activities up to 1600 Ci/kg U, the main part of the plant equipment of Eurochemic has to be decontaminated to allow cell entry for maintenance and modification of plant equipment. Decontamination comprised reduction of the radiation field at working areas from about 300 R/h down to about 10 mR/h. The decontamination operations carried out are described, giving details on methods used and the experience gained. A total of 13 kCi was removed from plant equipment using various types of decontaminants. (auth)

6119 OXIDATION-LIQUID SCINTILLATION RADIOASSAY OF PHENOLICS FROM CELLULOSE THIN-LAYER CHROMATOGRA-

PHY PLATES. Manners, G. D. (Dept. of Agriculture, Berkeley, CA). J. Chromatogr.; 90: No. 2, 275-283(10 Apr 1974).

A technique is described for the radioassay of ^{14}C-labeled phenolics removed from thin-layer chromatographic plates using cellulose nitrate solution. Samples are transferred to liquid scintillation vials for direct oxidation and $^{14}CO_2$ absorption preparatory to counting. High-efficiency counting results are recorded for the low-activity-level phenols with and without selective chromogenic spray detection. The method includes greater economy, and superior sample preparation and handling characteristics as advantages over other methods currently in use. (auth)

6120 THERMODYNAMIC CHARACTERISTICS OF THE PROCESSES OF FORMATION OF ACTINIDE COMPOUNDS IN A SOLID FORM. II. Heat Capacity and Linear and Bulk Thermal-Expansion Coefficients. Moskvin, A. I. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 364-367(1973).

Translated from Radiokhimiya; 15: No. 3, 362-366(1973).

The heat capacities of a series of actinide compounds, the heat capacities of their crystal lattices, and also the change in heat capacity on solution of actinide compounds of different types were calculated. The linear and bulk coefficients of thermal expansion of a series of actinide compounds were also determined by calculation. Definite rules were found for the changes in the thermodynamic characteristics of the formation of actinide compounds in the solid state. (auth)

6121 PREPARATION AND RADIOLABELLING OF MONODISPERSE LATICES. I. Preparation of Monodisperse Polystyrene and Polystyrene-Vinyl-Toluene Copolymer Latices. Udvarhelyi, K.; Szende, G. (Eoetvoes Lorand Tudomanyegyetem Kolloidkemiai es Kolloidtechnologiai Tanszeke, Budapest). Magy. Kem. Foly.; 80: No. 2, 87-90(Feb 1974). (In Hungarian).

A simple method is presented for the production of monodisperse polystyrene and vinyl-toluene copolymer latices to be used in experiments with tracer technique. Different particle sizes from 0.1 to 1.5 μm of monodisperse latex are reproducibly prepared by emulsion polymerization using direct or "seed polymerization" method. The monodispersity and its time stability were confirmed by electron microscopy and particle size analysis. (auth)

6122 PREPARATION AND RADIOLABELLING OF MONODISPERSE LATICES. II. Preparation of ^{51}Cr-Labelled Polystyrene Latex. Szende, G.; Udvarhelyi, K. (Eoetvoes Lorand Tudomanyegyetem Kolloidkemiai es Kolloidtechnologiai Tanszeke, Budapest). Magy. Kem. Foly.; 80: No. 2, 90-92(Feb 1974). (In Hungarian).

Gamma emitter-labelled polystyrene latex of a size similar to that of colloid particles and harmless to the living organism has been prepared for silicosis research. The labelling $^{51}Cr(aca)_3$ was built in during polymerization. The ^{51}Cr-labelled polystyrene latex has proved to be monodisperse and the incorporation of the ^{51}Cr-isotope in the polystyrene particles was found to be of high stability. (auth)

6123 X-RAY CRYSTAL STRUCTURES OF β-UOF_4. Taylor, J. C.; Wilson, P. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Chem. Soc., Chem. Commun.; No. 6, 232-233(20 Mar 1974).

β-UOF_4 is tetragonal and is isostructural with β-UF_5, having, around each uranium atom, a pentagonal bipyramid, which consists of six fluorine atoms and one oxygen atom. (auth)

6124 CYCLOOCTATETRAENYL COMPOUNDS OF ACTINIDE ELEMENTS. Part 2. Bis-(Cyclooctatetraenyl)Protactinium(IV). Goffart, J.; Fuger, J.; Brown, D.; Duyckaerts, G. (Univ., Liege). Inorg. Nucl. Chem. Lett.; 10: No. 5, 413-419(May 1974).

From symposium on recent aspects in actinide chemistry; Liege, Belgium (3 May 1973).

The preparation of a new organometallic compound, $(C_8H_8)_2Pa$, is reported. It has been characterized by ir spectrometry and x-ray powder diffraction analysis. (auth)

6125 RADIOCHEMICAL PURIFICATION OF THE ^{32}P-LABELLED YEAST RIBONUCLEIC ACIDS. Gniazdowski, M.; Filipowicz, W.; Tuwim, B. (Akademia Medyczna, Lodz, Poland). Ann. Acad. Med. Lodzensis; 12: 31-44(1971). (In Polish).

Results of investigations on the radiochemical purification of RNA alkaline hydrolyzates are presented. The different RNA fractions were obtained from the yeast incubated with ^{32}P-orthophosphate. The influence of some steps of the RNA preparation procedure on RNA purity is discussed. Several compounds (nucleoside-5'-monophosphates, nucleosidediphosphates, nucleosidetriphosphates and inorganic phosphates: orthophosphate, pyrophosphate, tripolyphosphate, trimetaphosphate and a mixture of polyphosphates containing from 2 to 9 phosphate residues) which could potentially contaminate the RNA preparations were tested on their behavior on the paper chromatograms in the following solvents: n-propanol-ammonia-water and 2% boric acid-ammonia-ethanol. Using these solvents, the products of RNA alkaline hydrolysis [nucleotide-2' (3')-monophosphates] can be separated from all compounds listed above with an exception of orthophosphate. The results of ^{32}P distribution among the nucleotides separated by two different methods: paper chromatography in n-propanol-ammonia-water and isobutyric acid-ammonia solvents and paper electrophoresis were compared and influence of the hydrolysate purification with charcoal on these results was examined. When alkaline hydrolysates of all highly polymerized RNA fractions were chromatographed with 2% boric acid-ammonia-ethanol, 94-99% of radioactivity applied on the paper has been found in a spot containing nucleoside-2' (3')-monophosphates. In this solvent sRNA fraction has been found to contain 20-40% of impurities. The influence of some analytical steps on RNA purification and possible errors related to the procedure suggested are discussed. (auth)

6126 URANYL COMPLEXES OF NEW MACROCYCLIC LIGANDS. Casellato, U.; Vidali, M.; Vigato, R. (Consiglio Nazionale delle Richerche, Padua). Inorg. Nucl. Chem. Lett.; 10: No. 3, 437-441(May 1974).

It is stated that the synthesis and properties of metal complexes derived from macrocyclic ligands are of considerable interest. The synthesis of multidentate cyclic ligands are facilitated by the template effect of metal ions. Macrocyclic ligands that allow the incorporation of two metal ions have been synthesized. The present report describes the synthesis, via the template effect, of uranyl complexes with macrocyclic ligands. The preparation of the complex N,N'-bis(3-formyl-5-chlorosalicylidene)-1,5-diamino-3-azapentane dioxouranium(VI) is discussed. The structure of this complex (referred to as $[UO_2A]$) is proposed, and its reactions with diamines to form macrocyclic complexes $[UO_2B]$ are considered. Finally, the reactions between $Fe(ClO_4)_3$, $Co(ClO_4)_2$, $Cu(ClO_4)_2$, $Ni(ClO_4)_2$ and $[UO_2B]$ complexes are discussed. (UK)

6127 CHEMICAL STABILIZATION OF DAUGHTER ^{99m}Tc AFTER THE β-DECAY IN CHELATE SYSTEMS WITH MOLYBDENYL (^{99}Mo). Mikulaj, V.; Rajec, P.; Faberova, V. (Komenskeho Univ., Bratislava). Chem. Zvesti; 28: No. 1, 37-46(1974).

Chemical consequences of the β-decay of ^{99}Mo in molecules of the type MoO_2L_2 (L is a chelating ligand) were studied. 8-Hydroxyquinoline, α-benzoinoxime, and N-benzoyl-N-phenylhydroxylamine were used as chelating agents. Kinetics of extraction of $^{99}Mo(VI)-^{99m}Tc$ with chloroform solutions of chelating agents from aqueous HCl or H_2SO_4, kinetics of stripping of chelates from chloroform solutions and extractability of Tc(VII), Tc(V), and Tc(IV) were investigated. According to the results, daughter ^{99m}Tc is stabilized in oxidation state V in high yields (80 to 100%). $^{99m}Tc(V)$ is in general unstable and its stability in the chloroform-water two-phase system depends on its ability to form chelates with chelating agents. The formation of $^{99m}Tc(V)$ is explained by preservation of the metal-oxygen bonds, which are not much affected by phenomena accompanying the β-decay. The notable stabilizing effect on $^{99m}Tc(V)$ oxocation is exhibited mainly by 8-hydroxyquinoline and α-benzoinoxime. The former stabilized daughter ^{99m}Tc as a chelate of the assumed composition TcO_2Ox. Its yield (90-100%) was only slightly dependent on the aqueous phase composition. (auth)

6128 ISOTOPE-DILUTION ANALYSIS OF RATE-LIMITING STEPS AND POOLS AFFECTING THE INCORPORATION OF THYMIDINE AND DEOXYCYTIDINE INTO CULTURED THYMUS CELLS. Sjostrom, D. A.; Forsdyke, D. R. (Queen's Univ., Kingston, Ont.). Biochem. J.; 138: No. 2, 253-262(Feb 1974).

The effects of various quantities of thymidine or deoxycytidine (0 to 30 μM) on the radioactive labeling of cells with the corresponding radioactive deoxynucleoside were examined. From rat thymus of the isotope-dilution plots, values were obtained for the V maximum of the rate-limiting step governing incorporation of the deoxynucleoside, and the concentration of the pool of compounds competing with the radioactive deoxynucleoside at the rate-limiting step. Isotope-dilution plots for deoxycytidine were linear, whereas plots for thymidine were bimodal, indicating an abrupt increase in both the V maximum and pool concentration at a critical thymidine concentration (~5 μM). The bimodality was removed by amethopterin. The V maximum determined with deoxy-[U-^{14}C] cytidine was approximately equal to the sum of the V maximum determined with deoxy[5-^3H]cytidine and the V maximum determined with [Me-^3H] thymidine at thymidine concentrations above 5 μM. The thymidine competitor pool at thymidine concentrations above 5 μM was approximately equal to the sum of the deoxycytidine competitor pool and the thymidine competitor pool at thymidine concentrations below 5 μM. The pools were independent of cell concentration and dependent on serum concentration. Results are explained on the basis that deoxycytidine in

serum (16 μM) is the major source of both cytosine and, by the way of thymidylate synthetase, thymine, in the DNA of thymus cells. Serum deoxycytidine normally maintains a sufficient intracellular concentration of dTTP to inhibit partially the activity of thymidine kinase. When the dTTP concentration is lowered, by decreasing the concentration of deoxycytidine or by inhibiting thymidylate synthetase, the activity of thymidine kinase increases. The activity of thymidine kinase may also be increased by concentrations of thymidine greater than 5 μM, which overcome the inhibition of the enzyme by dTTP. At concentrations of thymidine below 5 μM, thymidine kinase limits the rate of labeling with [Me-^{3}H] thymidine and the radioactivity is diluted by a pool of unlabeled thymidine in serum (4 μM). At thymidine concentrations greater than 5 μM, the activity of DNA polymerase limits the rate of labeling and the radioactivity is diluted both by serum thymidine and, indirectly by serum deoxycytidine. (auth)

6129 KINETICS OF THE OXIDATION OF PLUTONIUM(IV) BY PERMANGANATE. Koltunov, V. S.; Zhuravleva, G. I. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 374-380(1973).

Translated from Radiokhimiya; 15: No. 3, 373-380(1973).

A study was made of the kinetics of the oxidation of Pu^{4+} ions by MnO_4^- ions in a perchloric acid medium with a solution ionic strength $\mu = 3$ in the temperature range of 5-50° with $[Pu^{4+}]_0 = 5 \cdot 10^{-4} - 1.8 \cdot 10^{-3}$ M, $[MnO^-]_0 = 4 \cdot 10^{-4} - 2.5 \cdot 10^{-2}$ M, $[Mn^{2+}]_0 = 1.3 \cdot 10^{-4} - 3.7 \cdot 10^{-3}$ M, and $[H^+] = 0.1 - 3.0$ M. The rate of the reaction is described by the equation $-d[Pu^{(IV)}]/dt = k[Pu^{(IV)}][Mn^{(II)}]/[H^+]^2$, where $k = 4070 \pm 210$ M · min^{-1} at 25° in the range $[H^+] = 1.5 - 3$ M. The thermodynamic parameters of activation were calculated: $\Delta H^* = 21.7$ kcal/mole, $\Delta S^* = 22.5$ entropy units, and $\Delta F^* = 15.0$ kcal/mole. The reaction mechanism, which includes the slow stage of the formation of the binuclear complex $(PuOMnOH_2)^{4+}$ and fast stages of the oxidation of this complex by MnO_4^+ ions, is discussed. (auth)

6130 SOLUBLE COMPOUNDS OF Pu(IV). I. Complex Formation of Pu(V) WITH OXALATE ION. Zaitseva, V. P.; Alekseeva, D. P.; Gel'man, A. D. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 386-390(1973).

Translated from Radiokhimiya; 15: No. 3, 385-390(1973).

The conditions under which Pu(V) exists in oxalate solution were determined. It was shown that, with high ratios of $C_2O_4^{2-}$: PuO_2^+ in solution, the rate of conversion of Pu(V) into Pu(IV) and Pu(VI) is very high. Solutions of Pu(V) containing ~$2.5 \cdot 10^{-3}$ mole/liter are relatively stable in the case of oxalate solutions with the ratio $C_2O_4^{2-}$: $PuO_2^+ < 5:1$. Spectrophotometric investigations showed that the maximum increase in the absorption density for complex formation by Pu(V) in oxalate solution is observed for a ratio $C_2O_4^{2-}$: $PuO_2^+ \approx 1:1$. Investigations of the electromigration of plutonium confirmed the formation of an anionic oxalate complex for Pu(V). The compound $NH_4PuO_2C_2O_4 \cdot 3-6H_2O$ was synthesized and isolated in a solid state. The instability of the oxalate complex ion $PuO_2C_2O_4^-$ was estimated as $2 \cdot 10^{-4}$. (auth)

6131 DISSOLUTION OF SOME URANIUM OXIDES IN SULFURIC ACID. Hinova, N. I.; Kozhina, I. I.; Rodionova, L. P.; Solntsev, V. M. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 391-396(1973).

Translated from Radiokhimiya; 15: No. 3, 391-397(1973).

The dissolution of the phase U_4O_9 and $\beta-U_3O_7$ proceeds with an insignificant change in the chemical composition. The formation of no other oxide phases was observed. No appreciable effect of the H_2SO_4 concentration on the limiting compositions was observed. The lower limit of the region of existence of the phase U_4O_9 at 90°C lies close to the composition $UO_{2.22\pm0.005}$ and that of the phase $\beta-U_3O_7$ close to the composition $UO_{2.29\pm0.005}$. For the phase $\gamma-U_3O_7$ and tetragonal and pseudocubic oxides with compositions from $UO_{2.37}$ to $UO_{2.45}$ the limiting compositions were found to depend on the H_2SO_4 concentration and the method of preparation of the oxides. The change in composition of these oxides is a reversible process. The lower limit of the region of existence of the phase $\gamma-U_3O_7$ at 90°C lies close to the composition $UO_{2.34\pm0.005}$. (auth)

6132 POLYMERIZATION OF U(VI) IN SOLUTIONS. Davydov, Yu. P.; Efremenkov, V. M.; Skriptsova, A. V. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 456-458(1973).

Translated from Radiokhimiya; 15: No. 3, 452-454(1973).

Determination of the conditions for the formation of polymers of U(VI), the degree of polymerization, and its changes with a change in the uranium concentration, and the solution pH were studied. The degree of polymerization of the uranyl ion in solution was determined by a dialysis method. The salts $^{233}UO_2(NO_3)_2$ and $^{233}UO_2(NO_3)_2$ were used for this study. (LK)

6133 REACTION OF D2EHPA AND ITS URANYL SALT WITH DILUENTS. I. Solutions of $(HR)_2$ and $UO_2(HR_2)_2$ in Hexane. Rozen, A. M.; Yurkin, V. G.; Rudenko, T. I.; Zel'venskii, M. Ya. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 442-444(1973).

Translated from Radiokhimiya; 15: No. 3, 441-443(1973).

From the vapor pressures of hexane the activity coefficients of HDEHP and its uranyl salt $UO_2(HR_2)_2$ were determined in mixtures with hexane at 10, 25, and 40°C. The data are described by two-parameter empirical equations. The heats of mixing were determined. The enthalpy of mixing is positive, while the nonideality of the solutions is negative. This situation arises because, due to dimerization of the extractant, which leads to an increase in the size of the molecules and a decrease in their polarity, the nonideality of the systems is determined by the athermal entropy effect. Accordingly, the data are described satisfactorily by equations of the zero approximation of Guggenheim's theory of strictly regular solutions. (auth)

6134 REACTION OF D2EHPA AND ITS URANYL SALT WITH DILUENTS. II. Solutions of $(HR)_2$ and $UO_2(HR_2)_2$ in Benzene. Rosen, A. M.; Yurkin, V. G.; Rudenko, T. I.; Zel'venskii, M. Ya. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 445-447 (1973).

Translated from Radiokhimiya; 15: No. 3, 444-445(1973).

From the vapor pressures the activity coefficents of HDEHP $[(HR)_2]$ and its uranyl salt $UO_2(HR_2)_2$ were determined in mixtures with benzene at 10, 25, and 40°C. The data are described by two-parameter empirical equations. The heats of mixing were determined. It was shown that the large negative nonideality of the solutions with an extremely low positive enthalpy of mixing is determined mainly by the thermal entropy effect, the role of which had increased because of dimerization of the HDEHP, leading to an increase in the size of the molecules and a decrease in both their polarity and their capacity for chemical interaction due to blocking of the phosphoryl oxygen. The data are described satisfactorily by the equations of Guggenheim's theory of strictly regular solutions. (auth)

6135 ABSORPTION SPECTRA OF CHLORIDE COMPLEXES OF NEPTUNYL. Vodovatov, V. A.; Mashirov, L. G.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 448-450(1973).

Translated from Radiokhimiya; 15: No. 3, 446-448(1973).

The electronic absorption spectra of solutions of chloride complexes of neptunyl in the so-called "inert" solvents CCl_4 and benzene were investigated. The required solubility of the complex was achieved by using tetradecylammonium as the outer-sphere cation or TBP and TOPO as the neutral ligand. (LK)

6136 PROTON RELAXATION IN AQUEOUS SOLUTIONS OF NpO_2^+. Vdovenko, V. M.; Kolokol'tsev, V. B.; Stebunov, O. B. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 451-453(1973).

Translated from Radiokhimiya; 15: No. 3, 448-450(1973).

From data on proton relaxation in aqueous solutions of pentavalent neptunium in the ternary systems NpO_2^+-diamagnetic salt-water the factors that determine the relaxation efficiency of paramagnetic NpO_2^+ ions in aqueous solutions were found. The parameters that characterize the long-range hydration of Mg^{2+} and UO_2^{2+} ions were estimated. (auth)

6137 RADIOCHEMICAL INVESTIGATION OF THERMAL DECOMPOSITION OF BISARENE COMPOUNDS OF CHROMIUM. Leonov, M. R.; Polozov, B. V.; Gladkova, G. V.; Artemov, A. N.; Petukhov, G. G. (Gorky State Univ., USSR). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 10, 2311-2313(Oct 1973).

Translated from Zh. Prikl. Khim.; 46: No. 10, 2171-2174(Oct 1973).

Films of metallic chromium formed by thermal decomposition of bis(benzene)chromium, bis(ethylbenzene)chromium, bis(mesitylene)chromium, and bis(isobutylbenzene)chromium, labeled with ^{14}C in the benzene ring, were found to contain 2.2, 3.0, 3.4, and 4.1% carbon respectively. Increase of the number and length of the alkyl-substituent chains in the benzene rings of the ligands raises the carbon content in the chromium films. It was found by a radiochemical method that contamination of chromium films with carbon is due more to carbon atoms from the ligand side chains than from the benzene rings. For example, for every six carbon atoms entering the chromium film from the benzene ring, six are derived from the side chain in decomposition of bis(ethylbenzene)-chromium, 11 in decomposition of bismesitylenechromium, and 20 in decomposition of bis(isobutylbenzene)chromium. There is a connection between thermal breakdown of the benzene ring and of alkyl side chains of the ligands. (auth)

6138 TEMPERATURE-DEPENDENT AFTER-EFFECTS OF THE COBALT-57-IRON-57 ELECTRON-CAPTURE REACTION IN $Cd_2[^{57}Co(CN)_6]_2 \cdot 12H_2O$. Fenger, J.; Olsen, J. (Danish Atomic Energy Commission, Risoe). J. Chem. Soc., Dalton Trans.; No. 3, 319-323(1974).

The Moessbauer emission spectrum of $Cd_2[^{57}Co(CN)_6]_2 \cdot 12H_2O$

was measured at temperatures between 78 and 323°K. Above 200°K the spectra can be resolved into two doublets; one is ascribed to $^{57}Fe(CN)_5^{3-}$ and one to $^{57}Fe(CN)_5^{2-}$; it is suggested that the pentacyanide is formed by a Coulomb explosion following an Auger process associated with the $^{57}Co(EC)^{57}Fe$-decay. Below 200°K a third species is detected; it may be Fe^{2+} formed by cyanide linkage isomerism. Measurements of the total intensity of the spectrum and the relative intensities of the individual doublets as a function of temperature permit in principle a determination of the f-factors for the species formed. It is estimated that the $^{57}Fe(CN)_5^{3-}$ has a formal Debye temperature of 170°K; at room temperature it is detected with a probability of only 50% of that of the $^{57}Fe(CN)_5^{2-}$. (auth)

6139 STABILITY OF HEXAMETHYLENEDIAMINETETRAACETATE AND IMINODIACETATE COMPLEXES OF THE RARE EARTHS Sc, AND Th. Kurkina, N. I.; Petrova, N. Yu.; Shorik, N. A. Zh. Neorg. Khim.; 19: No. 3, 661-664(Mar 1974). (In Russian).

The stability constants were determined, at an ion strength of 0.1 and 25°C, of La, Sc, and Th compounds, MA, where A^{2-} is the anion of iminodiacetic acid (Imda); of the Sc, Th, and RE complexes of MHA, where HA^{3-} is the monoprotonated residue of Hemdta; and of LaH_2A, where H_2A^{2-} is the residue of Hemdta. The similarity in stability of the La, Sc, and Th complexes with the A^{2-} and HA^{3-} anions indicates an identical dentation of these anions. (tr-auth)

6140 THALLIUM(I)–URANATES(VI). Giridharan, A. S.; Udupa, M. R.; Aravamudan, G. (Indian Inst. of Tech., Madras). Z. Anorg. Allg. Chem.; 403: No. 2, 211-217(Jan 1974).

The solid-state preparation, thermal and hydrolytic characteristics of thallium(I)–uranates(VI) are described. The phases identified were Tl_2UO_4, $Tl_2U_2O_7$ and a range of solid solution ($Tl_2O \cdot 2{,}33\ UO_3$–$Tl_2O \cdot 6\ UO_3$). The thallium uranates are isostructural with the corresponding potassium uranates. $Tl_2U_2O_7$ is the stable phase formed from the other uranates on hydrolytic treatment. The thallium uranates lose thallium(I) oxide on heating to temperatures above 750°C and the order of thermal stability is $Tl_2U_6O_{19} \sim Tl_2U_3O_{10} \sim Tl_2U_2O_7 \gg Tl_2UO_4$. (auth)

6141 CARBOTHERMIC METHOD FOR CONVERTING A REACTIVE METAL OXIDE TO METAL OR NITRIDE FORM IN A SPECIFIC MOLTEN METAL SOLVENT. Anderson, R. N.; Parlee, N. A. D. (to Parlee Anderson Corp.). British Patent 1,342,991. 9 Jan 1974. Filed date 18 Jan 1971. 18p.

In the process described the oxide is reacted with C or a C source material in excess of stoichiometric requirements above 600°K in a molten metal solvent that lowers the activity of the reduced metal to a level below that required for carbide formation under the prevailing reaction conditions. The molten metal solvent is capable of forming stable intermetallic compounds with the reduced metal. The partial pressure of the CO present over the reaction mixture is maintained at a level below the equilibrium value for the reaction mixture as reduction of the oxide takes place. The preferred solvent metals are Sn, Cu, and Fe, but various other metals can be employed either alone or as alloys. Where nitride is required a N_2 atmosphere is maintained over the molten metal solvent, using a N_2 partial pressure sufficient to cause combination of the reduced metal to form insoluble nitride, which is precipitated. The process may be applied to the preparation of UN. The nitride may also be converted to metal. Phase separation of the metal may be accomplished by providing a H_2-containing atmosphere over the molten metal solvent, using a H_2 partial pressure sufficient to cause hydride formation and at a temperature below that at which the metal hydride decomposes, thus forming insoluble hydride, which is converted to metal by distillation. (UK)

6142 PEROVSKITE PHASES IN THE SYSTEMS AO–SE_2O_3–UO_{2+x} WITH A = ALKALINE EARTH METAL AND SE = RARE EARTHS, La, AND Y. VI. IR Spectroscopial Investigations of The Compounds $Ba_2SE_{0.67}UO_6$ and $Ba_2SF_{0.67}UO_{5.5}$. Kemmler-Sack, S. (Univ., Tuebingen, Ger.). Z. Anorg. Allg. Chem.; 403: No. 2, 149-155(Jan 1974). (In German).

According to the results of the ir spectroscopic investigations longer and shorter U–O-distances can be distinguished. The HT and TT modifications of $Ba_2SE_{0.67}UO_6$ contain UO_6^{2+}-groups like other ternary uranium oxides. In the O-modifications these groups are only incompletely formed. On the contrary the perovskites $Ba_2SE_{0.67}UO_{5.5}$ with U(V) show two different longer U–O bonds only. (auth)

6143 EVIDENCE AND APPLICATION OF GASEOUS COMPLEXES DURING THE CHEMICAL TRANSPORT. Schaefer, H. (Muenster Univ., Ger.). Z. Anorg. Allg. Chem.; 403: No. 2, 116-126(Jan 1974). (In German).

By means of the chemical transport method the formation of gaseous complex compounds was observed. Using Al_2Cl_6 as a transport agent, the chlorides $FeCl_2$, $CoCl_2$, $NiCl_2$, $CuCl_2$, $PdCl_2$, $PtCl_2$, $MoCl_3$, YCl_3, $LaCl_3$, $ThCl_4$, and UCl_4 are transported within a temperature gradient. Similarly are transported by means of Ga_2Cl_6 the chlorides $CoCl_2$ and $NiCl_2$, by means of Fe_2Cl_6 the chlorides $FeCl_2$, $CuCl_2$ and YCl_3, by means of $NbCl_5$ the chlorides NaCl and $CrCl_2$. Examples concerning the practical application of gaseous complexes are given. (auth)

6144 BINARY SYSTEMS OF Rb AND Cs WITH ThF_4. Desyatnik, V. N.; Raspopin, S. P.; Trifonov, I. I. (Ural Polytechnic Inst., Sverdlovsk, USSR). Zh. Neorg. Khim.; 19: No. 3, 842-843(Mar 1974). (In Russian).

Differential-thermal and x-ray analyses were used to study the binary systems RbCl–ThF_4 and CsCl–ThF_4. Melts of RbCl–ThF_4 form one compound, $RbCl \cdot 7ThF_4$, which melts incongruently at 720°C, and a eutectic of 40 mole % ThF_4, which melts at 647 ± 2°C. Melts of CsCl–ThF_4 form a congruently melting compound, $CsCl \cdot 2ThF_4$, and two eutectics. The eutectic formed by CsCl with $CsCl \cdot 2ThF_4$ contains 53 mole % CsCl and melts at 560 ± 2°C; the eutectic of $CsCl \cdot 2ThF_4$ with ThF_4 contains 20 mole % CsCl and melts at 747 ± 2°C. (tr-auth)

6145 URANYL COMPLEXES WITH ACID HYDRAZINES. Kharitonov, Yu. Ya.; Shchelokov, R. N.; Machkhoshvili, R. I.; Generalova, N. B. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 19: No. 3, 854-856(Mar 1974). (In Russian).

Uranyl complexes with hydrazines of a number of carboxylic acids were prepared and briefly characterized. (tr-auth)

6146 CRYSTAL AND MOLECULAR STRUCTURE OF BIS(PROTONATED THIAMINE)TETRACHLORODIOXOURANIUM(VI). Clemente, D. A.; Bandoli, G.; Benetollo, F.; Marzotto, A. (Consiglio Nazionale delle Ricerche, Padua). J. Cryst. Mol. Struct.; 4: No. 1, 1-14(Jan 1974).

The crystal and molecular structure of bis(protonated thiamine) tetrachlorodioxouranium(VI), $[C_{12}H_{18}ClN_4OS]_2UO_2Cl_4$, has been determined from three-dimensional x-ray diffractometer data. The crystals are monoclinic: $P2_1/n$, a = 11.199, b = 6.968, c = 23.675 Å, β = 97.50°, Z = 2. The structure was determined by Fourier methods and refined by least squares to R = 0.062, using 1675 observed reflections. The structure contains octahedral $[UO_2Cl_4]^{2-}$ ions with average U–Cl and U–O distances of 2.67(1) and 1.78(1) Å, respectively. The organic portion of the molecule resembles that of previously reported thiamine structures. The failure to find the hydrogen atoms no doubt prevented our determining either which nitrogen atom is protonated or, with certainty, the hydrogen-bonding distribution. (auth)

6147 PREPARATION OF SODIUM [$^2H_1$] ACETATE WITH EXCEPTIONAL ISOTOPIC PURITY. Robinson, D. A. (Cambridge Univ., Eng.). J. Chem. Soc., Chem. Commun.; No. 9, 345-346(8 May 1974).

Sodium [$^2H_1$] acetate of >99% isotopic purity was obtained from bromoacetic acid in a mild debromination procedure employing zinc dust. (auth)

6148 RATE EQUATION FOR THE REACTION OF URANIUM WITH HYDROGEN. Hashino, T. Tech. Rep. Inst. At. Energy, Kyoto Univ.; No. 164, 1-19(Mar 1974).

The theoretical background of the rate equation proposed in J. Phys. Chem., 77: 2236 (1973) is given. The equation is derived from the classical theory of rate processes, in view of the fact that Lacher's isotherm is within the domain of statistical thermodynamics. According to the Wicke's mechanism it is assumed that the reaction is rate-determined by the jumping of hydrogen atom from a chemisorption site to the adjacent interstitial site. Unlike usual treatment for diffusion, the calculation of the potential energy barrier for the hydrogen jumping, because uranium metal suffers a considerable lattice deformation on the reaction as a result of the strong mutual interaction forces among the uranium and hydrogen atoms in the solid phase. As an approximate treatment, the problem is solved with the aid of the continuum theory of lattice defects developed by Eshelby. Thus, the potential energy barrier, including the contribution of the mutual interaction of hydrogen atoms which characterizes Lacher's isotherm, can be obtained in terms of the strain energy, regardless of the nature of the mutual interaction forces. It is shown that the rate equation derived is sufficient to explain the peculiar phenomena which the system exhibits. (28 references) (auth)

6149 EFFECT OF ZIRCONIUM AND THORIUM NITRATES ON THE LIQUID–VAPOR EQUILIBRIUM IN THE WATER–NITRIC ACID SYSTEM. Efimov, A. N.; Zhikharev, M. I.; Zhirnov, Yu. P.; Chilikin, A. Ya. Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 8, 1208-1209(Aug 1973).

Translated from Zh. Fiz. Khim.; 47: No. 8, 2136(Aug 1973).

The liquid-vapor equilibrium in the water–nitric acid–zirconium (or thorium) nitrate system was investigated by a circulation method. The salts have a salting-out effect on nitric acid, thorium nitrate having the most marked effect among virtually all the available metal nitrates. (auth)

6150 EFFICIENT BIOSYNTHETIC METHOD TO PREPARE FATTY ACYL CHAINS HIGHLY ENRICHED WITH ^{13}C. Cronan, J. E.; Batchelor, J. G. (Yale Univ., New Haven). Chem. Phys. Lipids; 11: No. 3, 196-202(Oct 1973).

In order to overcome the limitations of the biosynthetic methods previously used for the ^{13}C enrichment of fatty acids, a mutant of E. coli was constructed which incorporates added ^{13}C-acetate into fatty acid very efficiently. When ^{13}C-acetate is supplied in the growth medium, at least 70% of the added acetate is converted to fatty acid and the fatty acid has a specific enrichment comparable of that of the original ^{13}C-acetate. This method which has been developed for the biosynthetic incorporation of ^{13}C-acetate into fatty acyl chains combines high specific enrichment and high utilization of the acetate. (INIS)

6151 OXIDATION–REDUCTION REACTIONS OF ACTINIDE ELEMENTS. XXII. Kinetics and Mechanism of Reaction of Americium(III) With Peroxydisulfate Ions in Potassium Carbonate Solutions. Ermakov, V. A.; Rykov, A. G.; Timofeev, G. A.; Dzhadav, A. V.; Yakoviev, G. N. (Baba Center of Atomic Studies, Bombay). Sov. Radiochem. (Engl. Transl.); 15: No. 3, 381-385 (1973).

Translated from Radiokhimiya; 15: No. 3, 380-385(1973).

In carbonate solutions the oxidation of americium(III) to americium(VI) by $S_2O_8^{2-}$ ions proceeds through the intermediate formation of americium(V). The rate of oxidation of americium(III) to americium(V) is independent of the concentration of potassium carbonate and the total concentration of americium and equals the rate of decomposition of $S_2O_8^{2-}$ ions. The rate of oxidation of americium(V) to americium(VI) is directly proportional to both the concentration of $S_2O_8^{2-}$ ions and the total concentration of americium and inversely proportional to the concentration of potassium carbonate. A kinetic scheme is proposed for the reaction, which explains the experimental relations of the reaction rate to the composition of the solution and the concentrations of the reactants. (auth)

6152 FLUORO COMPLEXES OF URANIUM(IV). Part IV. The Far Infrared Spectra of Fluoro Complexes of Uranium(IV). Satpathy, K. C. (Sambalpur Univ., India); Sahoo, B. J. Indian Chem. Soc.; 50: No. 7, 452-454(Jul 1973).

The far ir spectra of several fluoro-complexes of uranium(IV) have been studied in the metal halogen stretching frequency region (500–300 cm^{-1}) and have been compared with the ir band for uranium tetrafluoride and the available ir data of the fluoro-complexes of actinides(V). The complexes of the type, $M^{II}M^{IV}F_6$ such as, $(enH_2)(UF_6)$ show the metal halogen vibrational band in the region 420–440 cm^{-1} as compared to 420 cm^{-1} in uranium tetrafluoride, and indicate that uranium(IV) ion in the hexafluoro-complexes is 8-coordinated. On the other hand, complexes of the type $M^IM^{IV}F_5$ such as $(CH_3NH_3)UF_5$ show the metal-halogen vibrational band at a higher frequency region, which are located in the range 460–470 cm^{-1} indicating a lower coordination number about uranium(IV) ion than the hexafluoro-complexes. The most probable coordination number about the uranium(IV) ion in these complexes is seven. The present study shows that the complexes formed by the organic ammonium fluorides with uranium(IV) fluoride are significantly different from the alkali fluoride-actinide(IV) fluorides. The apparent differences are not, however, surprising, but the effect of the large size of the organic ammonium groups is. (auth)

6153 ELECTROCHEMICAL AND SPECTROPHOTOMETRIC STUDY OF THE COMPLEXES OF PLUTONIUM AND EDTA IONS. Cauchetier, P.; Guichard, C. (CEN, Fontenay-aux-Roses, France). Radiochim. Acta; 19: No. 3, 137-146(Jan 1973). (In French).

The influence of EDTA concentration and pH on the behavior of plutonium(III) and (IV) in solution was studied. It appears that plutonium(IV) gives a complex PuY (pK = 25.6) with a weak acidic form $HPu(EDTA)^+$ (pK = 2.6). Although plutonium(III) is quickly oxidized in presence of EDTA chiefly in acidic media, it gives also a complex PuY^- (pK = 12.2) with a weak acidic form HPuY (pK = 4.2). The absorbance spectra of the various complexes and corresponding polarographic curves are shown. The equilibrium potential of the pair $PuY–PuY^-$ is −0.040 V/SCE. There is no evidence to prove the existence of hydroxylated complexes; there is probably only competition between EDTA and the hydroxyl ions. (GE)

6154 STUDIES ON THE ELECTROREDUCTION OF URANIUM(IV) IN MOLTEN LiF–BeF_2–ZrF_4 BY SQUARE WAVE VOLTAMMETRY. Manning, D. L.; Mamantov, G. (Oak Ridge National Lab., TN). Electrochim. Acta; 19: No. 4, 177-179 (Apr 1974).

A report is presented on the application of square wave polarography to studies of solute species in molten salt solutions. The reversible U(IV) → U(III) electrode reaction in molten LiF–BeF_2–ZrF_4 was used. From preliminary results it is concluded that square wave voltammetry appears well suited for the study of electrode reactions in molten salts. The apparent rapid decay of double layer charging makes it feasible to use higher square wave frequencies than normally used for aqueous systems. (UK)

6155 INFRARED SPECTRA AND STRUCTURE OF SOME MATRIX-ISOLATED LANTHANIDE AND ACTINIDE OXIDES. Gabelnick, S.D.; Reedy, G.T.; Chasanov, M.G. (Chemical Engineering Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 60: No. 3, 1167-1171 (1 Feb 1974).

The midinfrared spectra of the oxides of Ce, Pr, Sm, Eu, Tb, and Th have been obtained by vaporizing the solid oxides and trapping the vapor species in argon matrices. On the basis of oxygen-18 isotope shifts, a linear structure has been determined for PrO_2, and nonlinear structures for CeO_2, TbO_2, and ThO_2. Values of ω_e and $\omega_e x_e$ have been determined for the monoxides of Pr, Eu, Tb, and Th from the small deviations between the observed and the theoretical harmonic isotope shifts. (auth)

6156 LOW TEMPERATURE MAGNETIC SUSCEPTIBILITY OF UCl_4. Gruber, J.B. (Department of Physics, Washington State University, Pullman, Washington 99163); Hecht, H.G. J. Chem. Phys. 60: No. 4, 1352-1354 (15 Feb 1974).

The magnetic susceptibility of powdered UCl_4(s) has been measured in the temperature range 4–300 °K using the Faraday method. The data are qualitatively consistent with our previous analysis of the optical spectrum, but suggest that the first excited Γ_5 level should lie at approximately 110 cm^{-1} above the ground state. (auth)

6157 BIS(π-CYCLOOCTATETRAENE)PROTACTINIUM. Starks, D. F.; Parsons, T. C.; Streitweiser, A. Jr.; Edelstein, N. (Univ. of California, Berkeley). Inorg. Chem.; 13: No. 6, 1307-1308(Jun 1974).

Bis(π-cyclooctatetraene)protactinium, $Pa(C_8H_8)_2$, has been prepared on a micromolar scale by reaction of $K_2C_8H_8$ with $PaCl_4$ in THF. The golden yellow sublimate was characterized by the x-ray powder pattern which is consistent with data for the isostructural compounds $Th(C_8H_8)_2$ and $U(C_8H_8)_2$. A solvent-free preparation of the latter compounds is described from the metal tetrafluoride and MgC_8H_8. (auth)

6158 MAGNETIC PROPERTIES OF THE TRICHLORIDES, TRIBROMIDES, AND TRIIODIDES OF U(III), Np(III), AND Pu(III). Jones, E.R. Jr.; Hendricks, M.E. (Department of Physics and Astronomy, University of South Carolina, Columbia, South Carolina 29208); Stone, J.A.; Karraker, D.G. J. Chem. Phys. 60: No. 5, 2088-2094 (1 Mar 1974).

Magnetic susceptibilities of uranium, plutonium, and neptunium trichlorides, tribomides, and triiodides were measured from 2.7°K to as high as 240°K with a vibrating-sample magnetometer at applied fields up to 12 kOe. Antiferromagnetic transitions were observed in UCl_3, $T_N = 22.0 \pm 1.0$°K; in UBr_3, $T_N = 15.0 \pm 0.5$°K; in UI_3, $T_N = 3.4 \pm 0.2$°K; and in $PuCl_3$, $T_N = 4.5 \pm 0.5$°K. A ferromagnetic transition at $T_c = 4.75 \pm 0.1$°K was found for PuI_3, and a slight hysteresis was measured at 2.7°K. Temperature-independent paramagnetism was observed for $NpCl_3$ below 50°K, for α-$NpBr_3$ below 30°K, and for NpI_3 below 15°K. All these latter compounds, and $PuBr_3$, exhibited Curie–Weiss paramagnetism at higher temperatures, with effective moments near the free-ion moments. The experimental magnetic susceptibility of $PuCl_3$ from 10 to 100°K agrees with the susceptibility calculated from crystal field energy levels and wavefunctions. (auth)

6159 MAGNETIC PROPERTIES OF TRIVALENT ACTINIDES IN THE OCTAHEDRAL COMPOUNDS Cs_2NaMCl_6. Hendricks, M.E.; Jones, E.R. Jr. (Department of Physics and Astronomy, University of South Carolina, Columbia, South Carolina 29208); Stone, J.A.; Karraker, D.G. J. Chem. Phys. 60: No. 5, 2095-2103 (1 Mar 1974).

The magnetic susceptibilities of U^{3+}, Np^{3+}, Pu^{3+}, Am^{3+}, Cm^{3+}, and Bk^{3+} ions in an octahedral environment were measured from 3 to about 50°K with a vibrating-sample magnetometer. Each actinide ion was in a stoichiometric compound of the cubic Cs_2NaMCl_6 type, except for Cm^{3+} and Bk^{3+}, which were doped into diamagnetic $Cs_2NaLuCl_6$. Curie–Weiss behavior was found for the uranium, neptunium, and plutonium compounds, with evidence for small distortions from octahedral symmetry in the uranium and plutonium compounds. The americium and berkelium samples displayed temperature-independent paramagnetism. For the curium sample, the free-ion moment was observed, but with deviations below 7.5°K that are attributed to crystal-field splitting of Cm^{3+}. The following ground levels were determined: U^{3+}, Γ_4; Np^{3+}, Γ_5; Pu^{3+}, Γ_4; Am^{3+}, Γ_1; and Bk^{3+}, Γ_1. In

Bk^{3+}, a Γ_7–Γ_8 separation of 85 cm^{-1} is derived. Limits on the octahedral crystal-field parameters were established from the magnetic data and from crystal-field calculations for U^{3+} and Np^{3+}, including intermediate coupling and J mixing from the first excited states. From these parameters, the complete crystal-field splitting of each actinide ion in Cs_2NaMCl_6 was calculated. (auth)

6160 TERNARY SYSTEM LiCl–NaCl–UCl_3. Desyatnik, V. N.; Dubinin, G. V. (Ural Polytechnical Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 84-85 (1973). (In Russian).

The fusibility diagram of the ternary system LiCl–NaCl–UCl_3 was investigated. It was established that LiCl and NaCl forms with UCl_3 a low-melting alloy which can be used as an electrolyte during the electrolytic production of U. (tr-auth)

6161 FUSIBILITY DIAGRAM OF THE LiCl–UCl_3–$ThCl_4$ SYSTEM. Vokhmyakov, A. N.; Desyatnik, V. N.; Kurbatov, N. N.; Raspopin, S. P. (Ural Polytechnical Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 86-87(1973). (In Russian).

The fusibility diagram of the LiCl–UCl_3–$ThCl_4$ system was determined by differential thermal analysis. It was established that in the ternary system there are mixtures with a low fusion temperature and these mixtures can be used as electrolytes for the production of Th and U. (tr-auth)

6162 MOLECULAR PARAMETERS AND DIMERIZATION OF CHLORINE TRIFLUORIDE. Morizot, P.; Ostorero, J.; Plurien, P. (CEN de Saclay, Gif-sur-Yvette, France). J. Chim. Phys.; 70: No. 11, 1587-1591(Nov 1973). (In French).

The viscosity coefficient of chlorine trifluoride was measured between 50 and 150°C at pressures of 100 Torr. The nonideality coefficient was obtained between 50 and 200°C. These measurements were completed by the determination of the viscosity at 81°C and diffusion coefficients at 21.3°C of the binary mixture UF_6–ClF_3. The transport properties give the values of the parameters of the Lennard–Jones potential for chlorine trifluoride: $\sigma = 5.07A$; $\epsilon/k = 160°K$. The use of these parameters to interpret the non-ideality values indicate a small dimerization of the vapor phase: $\Delta H = -3.6$ kcal/mole; $\Delta S = -20$ cal/mole K. (FR)

6163 INVESTIGATION OF THE HYDROLYTIC PROPERTIES OF HEXAVALENT URANIUM. Davydov, Yu. P.; Efremenkov, V. M. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 4, 21-25(1973). (In Russian).

Conditions of mononuclear hydrolyzed complexes of hexavalent uranium formation are investigated. The first constant of uranyl-ion hydrolysis $K_1 = 3.7 \pm 1.5 \cdot 10^{-4}$ is calculated. (auth)

6164 IMMUNOCHEMICAL PROPERTIES OF IMMUNOGLOBULIN LABELLED WITH IODINE. Kulakov, V. N.; Ivanov, A. A.; Mozhaiskii, A. M.; Nevinnaya, A. P.; Stanko, V. I. (Inst. of Biophysics, Moscow). Isotopenpraxis; 10: No. 1, 13-18(Jan 1974). (In Russian).

The immunochemical properties of g-immunoglobulin of rabbits modified in two ways with the aid of iodine isotopes, through chemical iodination of albumin using sodium iodide in the presence of iodine chloride and through potentiostatic iodination in an electrochemical cell, are being compared. It is shown that iodination in the potentiostatic way involves smaller changes of the immunochemical properties of immunoglobulin when compared with unmodified albumin than chemical iodination. (auth)

Radioactive Waste Treatment

Refer also to abstract 5966.

6165 (BARC/I–52) INACTIVE SCRAP MONITORING IN BARC. Watamwar, S. B.; Bhargava, Y. B.; Mani, S. P. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 4p. INIS.

The Radiation Hazard Control Section of the Health Physics Division has initiated a scrap monitoring programme consisting of three stages in order to prevent contaminated scrap from getting mixed up with uncontaminated scrap in the Bhabha Atomic Research Centre, Bombay before the removal of scrap from the establishment. Description of the monitoring techniques is given in brief. It has been effective not only in minimizing active materials going out of the establishment, but also in controlling them so that they would not be harmful when released for public use. The number of incidents of active scrap getting mixed with inactive scrap is minimized. A table showing results of a plant-wide scrap collection involving active scrap mixup with inactive scrap for the period Nov. 1966 to Dec. 1969 is given. Two figures show monthwise distribution of contamination incidents and plant-wise distribution of contamination incidents for the period 1966 to 1969, respectively. (INIS)

6166 (BNL-18830) DEVELOPMENT OF DURABLE LONG TERM RADIOACTIVE WASTE COMPOSITE MATERIALS. Progress Report No. 6, January–March 1974. Colombo, P. (Brookhaven National Lab., Upton, N. Y. (USA)). Apr 1974. 31p. Dep. NTIS $4.75.

Leaching data for aqueous $NaNO_3$ cement concrete composites are reviewed. The leach rates for high alumina cement composites containing 29.8 wt % $NaNO_3$ are independent of specimen size over a volume factor of 55. Cement-concrete composites containing 5 to 30 wt % $NaNO_3$ were irradiated for total doses of 10^9 rads. The compressive strengths and leachability for irradiated specimens were the same as for the controls. Similar radiation experiments were performed using portland type II cement. The results showed no effect of radiation (10^9 rads) on strength and leachability properties. Addition of fly-ash and pumice to portland cement–$NaNO_3$ formulations did not have any appreciable effect in lowering the leach rates. These materials react with $Ca(OH)_2$, a soluble by-product of portland cement hydration to form insoluble cementaceous materials. Radiation stability studies were conducted for Al_2O_3 calcine composites containing ≈ 40% wt % Al_2O_3. The composites in the form of cement-concrete, polymer-impregnated concrete and polymer concrete were irradiated to 10^{10} rads. No apparent difference in strength and leachability properties was observed as compared to controls. Studies were conducted for gas evolution from impregnated Al_2O_3 calcine composites subjected to ^{60}Co-gamma radiation. The gases evolved at 10^9 and 10^{10} rads were collected and analyzed. The yields, in terms of $G(H_2)$ and G(carbon), ranged from 0.005 to 0.043 and from 0.0017 to 0.0035 respectively. Weight losses based on the weight of the total composite were ≈ 0.1%. Calculations to develop process flow sheets for the incorporation of intermediate-level liquid wastes into concrete have been started. Emphasis will be initially on BNL waste. A computer program was written to calculate the thermal stresses generated inside of solid radioactive concrete cylindrical forms of the type under study at BNL and for materials such as glasses, metals, and bitumens. (auth)

6167 (BNWL-SA-4986) NUCLEAR WASTE FIXATION. McElroy, J. L.; Mendel, J. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 31p. (CONF-740434-3). Dep. NTIS $4.75.

From waste management symposium; Tucson, Arizona, USA (21 Apr 1974).

Current waste management research and development is directed toward near-term technology for the fixation of commercially produced high-level wastes in silicate glass or ceramic forms. Second, a comprehensive examination of potential advanced waste forms is being carried out which may offer further increments of safety or economy over the long term. (auth)

6168 (ETR-263) BITUMINIZATION OF MEDIUM-LEVEL WASTE AND HIGH ENRICHED WASTE CONCENTRATE AT EUROCHEMIC. Hild, W.; Eschrich, H.; Joseph, C. J.; Schneider, E. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Nov 1971. 26p. INIS.

The procedures and the equipment foreseen for the solidification of Eurochemic's intermediate-level radioactive wastes (decladding solutions and hot waste concentrate) and the high enriched waste concentrate (fission product solution from MTR-fuel reprocessing) by homogeneous incorporation of the chemically pretreated waste solutions into blown bitumen are described. The characteristics of the different waste solutions and a description of the chemical pretreatment and engineering flowsheets are given. (auth)

6169 (ETR-275) EFFECTS OF MICROORGANISMS ON BITUMINOUS MATERIALS. A Literature Review. Drent, W. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Jun 1972. 21p. INIS.

A review, with 32 references, is given of the literature on the effects of microorganisms on bitumen. Long-range studies on this problem in relation to the incorporation of radioactive wastes into bitumen are recommended. (auth)

6170 (ETR-278) MANAGEMENT OF FUEL REPROCESSING WASTES AT EUROCHEMIC. Eschrich, H.; van Geel, J.; Detilleux, E. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). 1972. 21p. INIS.

From NEA–IAEA symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The present practices, current developments and future aspects of the treatment and storage of Eurochemic's fuel reprocessing wastes are reviewed. Data on the production and characteristics of the various types of radioactive effluents, resulting from the different steps of the chemical processing of low- and

high-enriched uranium fuels, are presented. Recent developments on a low-temperatures process for the solidification of high-level wastes and on the bituminization process for medium level wastes, are summarized. New procedures are described which are applicable to the treatment of spent tributyl phosphate–kerosene solvents. Finally the future waste management policy at Eurochemic is outlined. (auth)

6171 (IAEA-R-610-F) STUDY OF BULGARIAN BITUMENS AND NATURAL SORBENTS FOR USE IN THE PROCESSING AND DISPOSAL OF RADIOACTIVE WASTES. Final Report, 1 June 1968–31 March 1972. Daiev, Kh. (International Atomic Energy Agency, Vienna (Austria)). May 1972. 13p. (In Russian). INIS.

Radioactive waste decontamination by natural sorbents and immobilization radioactive sorbents by some bitumens were developed. The process is economically attractive to those establishments where there are small waste volumes, low radioactivity concentrations (10^{-3}–10^{-1} mCi/l), and presence of limited number of radionuclides. Decontamination coefficients higher than 98% were achieved for ^{137}Cs, ^{204}Tl, ^{110m}Ag, ^{90}Sr, and ^{45}Ca using combination of the sorbents. The investigators have designed a multistage chill-mound unit and a semi-automatic pilot scale Nkh-2 unit for bituminization of radioactive sorbents. Bituminous blocks produced by these units have shown satisfactory radiation and chemical stability and are suitable for long-term underground and ground disposal. The cost of the treatment and final disposal of 1 ton of liquid radioactive waste with activity level at 10^{-4}–10^{-9} Ci/l is about 264 Bulgarian Levas (official rate: 1 B. L. is about $1.08). (INIS)

6172 (IAEA-R-640-F) STUDIES ON DINONYLNAPHTHALENESULFONIC ACID AND ITS SODIUM SOAP AS LIQUID CATION EXCHANGERS AND THEIR APPLICATIONS TO TREATMENT OF RADIOACTIVE WASTES. Final Report, October 1, 1968–November 30, 1972. Wang, S. M. (International Atomic Energy Agency, Vienna (Austria)). Nov 1972. 65p. INIS.

The behavior of dinonylnaphthalenesulfonic acid (HD) and its sodium soap (NaD) as liquid cation exchangers has been investigated and their selectivities for various cations have been determined. Both HD and NaD were found to be able to extract anionic species from the aqueous solution due to their solubilization property. The absorption of iodide and chromate ions by HD and NaD has been studied. The use of HD in the organic solvents as an extractant has been shown to be an effective method for the separation of metallic ions with the proper choice of acid concentration and with the aid of some complexing agents. The separation of ^{233}Pa from the other mixed cations has been demonstrated. Because of their stability to gamma-ray radiation, HD and NaD can be used for radioactive liquid waste treatment. The method of treatment has been developed. (INIS)

6173 (ICP-1046) SUMMARY EVALUATION OF CANDIDATE FLUID-BED SOLIDIFICATION PROCESSES FOR USE IN THE NWCF. Freeby, W. A.; Rhodes, D. W.; Bodner, S. S.; Swink, D. G. (Allied Chemical Corp., Idaho Falls, Idaho (USA)). Apr 1974. Contract AT(10-1)-1375. 24p. Dep. NTIS $4.00.

Air fluidization, off-gas recycle, and steam fluidization are evaluated as process alternatives for the New Waste Calcining Facility. Emphasis in the study was on the capability of each process to reduce radiochemical and chemical emissions to as low as practicable. (auth)

6174 (JUL-1026-CT) INVESTIGATIONS ON THE USE OF EXTRUDERS IN THE GLAZING OF HIGHLY RADIOACTIVE FISSION PRODUCTS. Thiele, D. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Dec 1973. 19p. (In German). Dep. NTIS (US Sales Only) $4.00.

Fission product solutions resulting from the reprocessing of nuclear fuel elements can be secured and made unaffected by storage by melting them to glass blocks. Laboratory and technical testing lead to the proposal of a procedure which uses extrusion screws for the mixing of glass-forming agents and fission product solutions to give a good fusible pre-product. (GE)

6175 (LA-5544-PR) PERFORMANCE OF MULTIPLE HEPA FILTERS AGAINST PLUTONIUM AEROSOLS. Progress Report, July 1–December 31, 1973. Ettinger, H. J.; Elder, J. C.; Gonzales, M. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 12p. Dep. NTIS $4.00.

A multiple HEPA filter system has been evaluated using laboratory-produced plutonium aerosols with size characteristics substantially smaller than the 0.7-μm activity median aerodynamic diameter (amad) attained during the previous reporting period. Improved aerosol preparation by centrifugal ball milling of $^{238}PuO_2$ and subsequent nebulization of water suspensions has produced challenge aerosols with amad's in the range 0.3 to 0.5 μm, and in concentrations high enough for testing three HEPA filters in series. These aerosols contain 10% to 30% of total activity in the aerodynamic size range below 0.22 μm, allowing efficiency measurement of the first two HEPA filters in series for this size interval. Efficiencies of HEPA #1 and HEPA #2 have exceeded 99.98% for all sizes of plutonium aerosol, including the intervals 0.12 to 0.22 μm and <0.12 μm. Efficiency of HEPA #3 was 99.75% expressed as the average of eight runs. Tests now in progress are expected to show that several of the lowest HEPA #3 efficiencies (99.5%) were artifacts caused by low level counting problems, and that the actual HEPA #3 efficiency will exceed 99.75%. Limited field sampling at Location 00 is continuing with spectrum analysis of impactor samples providing separate particle size characteristics of ^{238}Pu and ^{239}Pu mixed in the process ventilation system. In conjunction with this field sampling, several coating materials are being applied to impactor plates to further evaluate particle rebound effects. Calculated exposures to alpha radiation due to Pu particles collected in the HEPA filter media are comparable to exposures causing observable effects in glass containers. Possible loss of efficiency in existing HEPA filters exposed to $^{238}PuO_2$ particles for 8 to 10 months will be investigated experimentally. (auth)

6176 (LA-UR-74-723) AEROSOL RESEARCH AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Ettinger, H. J.; Tillery, M. I.; Elder, J. C.; Gonzales, M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 20p. (CONF-740614-1). Dep. NTIS $4.00.

From Air Pollution Control Association meeting; Denver, Colorado, USA (10 Jun 1974).

Current research includes studies to define the performance of multiple (series connected) high efficiency filters against plutonium oxide aerosols; and theoretical calculations evaluating industrial air cleaner performance in terms of total mass collection, potential for particulate inhalation and lung deposition, estimation of visibility degradation, and production of condensation nuclei. Filter testing has required the development of plutonium oxide aerosols with aerodynamic size characteristics comparable to those produced under a variety of actual production and research operations. This involved development of milling and aerosol generation techniques to control particle size and minimize production of particle agglomeration. Experimental data using these submicron aerosols confirm that successive filter stages perform at or above minimum acceptable efficiency. Current studies are directed at evaluating filter performance for plutonium oxide aerosols as small as 0.1 μm. Performance characteristics have been calculated for different industrial air cleaners as a function of aerosol size. These have been calculated in terms of total mass, respirable mass, visibility degradation, and number concentration. In many instances the traditionally defined total mass collection efficiency does not provide a reliable index for predicting performance in terms of the other criteria which are of primary concern when evaluating health and environmental effects. (auth)

6177 EFFECT OF DETERGENTS ON DEACTIVATION OF WASTE SOLUTIONS BY ELECTROFLOTATION. Shvedov, V. P.; Yakushev, M. F. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 428-431(1973).

Translated from Radiokhimiya; 15: No. 3, 428-431(1973).

The effect of detergents on the extraction of radioactive isotopes by electroflotation is determined by anode processes, which depend, in their turn, on the structure of the detergents. Detergents with an alkyl structure and, in particular, soap are oxidized at the anode with the formation of carboxylate radicals which to some extent capture cations (including radioactive isotopes). A mixture of naphthenic and sulfonaphthenic acids is little affected by anode processes (only destructive oxidation processes are possible with a very low yield) and has hardly any effect on the extraction of radioactive isotopes by electroflotation. It may be surmised that the same will apply to other detergents with an alkylaryl structure. (auth)

6178 NEW METHOD FOR THE TREATMENT OF LOW-LEVEL RADIOACTIVE WASTES. Com. Naz. Energ. Nucl., Notiz.; 20: No. 3, 47-50(Mar 1974). (In Italian).

A new promising method for the treatment of low-level radioactive wastes seems to be that of acid digestion developed in the U. S. at the Hanford Engineering Development Laboratory and tested in a pilot plant recently opened there. The method and the plant are discussed. The purpose of the method is to reduce the bulk of the wastes and at the same time to make them incombustible to prevent fire hazards. (auth)

Radioisotope Production

Refer also to abstract 5965.

6179 (JAERI-M-5363) IRRADIATIONS DURING TEST UTILIZATION OF JMTR. Production of Radioisotopes. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 41p. (In Japanese). NTIS (US Sales Only).

The Division of JMTR Project, Oarai Research Establishment, Japan Atomic Energy Research Institute, had carried out series of the test irradiations during preliminary utilization of the JMTR to obtain techniques and data necessary for the future full-scale utilization. The Division of Radioisotope Production, Radioisotope Center, participated in the program, concerning radioisotopes production. Twenty eight kinds of target materials were irradiated, looking to the future possible requirements. Physical and chemical states of the irradiated materials were examined, as well as the problems involved in handling, and yields of the radioisotopes and neutron fluxes at the irradiation positions were determined. The results obtained were not largely different from those expected, and they would be useful for the future irradiations. (auth)

6180 CHOICE AND PREPARATION OF RADIOACTIVE GASES. Welch, M. J. (Washington Univ., St. Louis). pp 37-48 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

Methods for preparing radioisotopes of xenon and krypton and gases labeled with ^{11}C, ^{13}N, and ^{15}O are discussed. Xenon-135 and ^{127}Xe have the potential for wide commercial distribution. Carrier-free ^{135}Xe can only be made by uranium fission. The final product contains 5% ^{133}Xe. Xenon-135 prepared from enriched ^{134}Xe contains no impurities and the isotope could be distributed in the noncarrier-free form. The new isotope with the greatest potential for general distribution is ^{127}Xe; it can be produced in a carrier-free form from a cyclotron. (HLW)

6181 PRODUCTION OF ^{28}Mg IN A NUCLEAR REACTOR. Malinin, A. B.; Levin, V. I.; Kozyreva-Aleksandrova, L. S. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 422-427(1973).

Translated from Radiokhimiya; 15: No. 3, 422-427(1973).

A method is proposed for calculating the activity of ^{28}Mg formed in the linked reactions $^{6}Li(n,\alpha)t$, $^{26}Mg(t,p)^{28}Mg$ during the irradiation in a reactor of a mixture of substances containing lithium and magnesium. A method is demonstrated for taking into account the particle size of the substance irradiated in the calculation of the activity of ^{28}Mg in such mixtures. A simple method was developed for the chemical isolation of ^{28}Mg from targets and its purification to remove radioactive impurities, which is based on coprecipitation and adsorption. An experimental study was made of the effect of the degree of enrichment of the lithium in ^{6}Li and magnesium in ^{26}Mg and also the ratio of the numbers of ^{6}Li and ^{26}Mg atoms in the target on the specific activity of ^{28}Mg. The experimental values of the activities agree well with the calculated values. (auth)

6182 METHOD OF PREPARING ^{237}Np IN A RADIOCHEMICALLY PURE STATE. Ushatskii, V. N.; Preobrazhenskaya, L.D.; Gugel, E. S. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 454-455 (1973).

Translated from Radiokhimiya; 15: No. 3, 450-452(1973).

Neptunium-237 was freed from foreign radioactive elements and macrocomponents on two distribution columns. The stationary organic phase in one of them was undiluted TBP and in the other it was HDEHP. The support for the organic phase in the columns was powdered porous polytetrafluoroethylene with a grain size of 0.1-0.2 mm. The yield of neptunium was 98 ± 1.0%. (LK)

6183 THICK TARGET YIELD. Krasnov, N. N. (State Committee on Atomic Energy, Obninsk, USSR). Int. J. Appl. Radiat. Isotop.; 25: No. 5, 223-227(May 1974).

The present paper is related to a series of published works (Svoboda. The Uses of Cyclotrons in Chemistry, Metallurgy and Biology. (1970). Svoboda and Silvester. Int. J. Appl. Radiat. Isotop.; 22: 269 (1971). Lebowitz. Int. J. Appl. Radiat. Isotop.; 23: 203 (1972)) in which the question of units of measurement for the radioisotope rate of formation in reactions with charged particles is discussed. In this paper a rigorous definition of the so-called thick target yield Y is given, and the fundamental relation between the radioisotope activity and Y is derived. It is shown that in this formula the quantity Y is a physical constant which is related to the reaction cross section and to the so-called production rate R. It is seen from the data given that the thick target yield is a convenient characteristic of the radioisotope formation rate. (auth)

6184 PREPARATION OF ^{81}Rb IN HIGH SPECIFIC ACTIVITY QUANTITIES AND ITS USE IN A $^{81}Rb-^{81m}Kr$ GENERATOR. Mayron, L. W.; Kaplan, E.; Friedman, A. M.; Gindler, J. E. (Veteran's Administration Hospital, Hines, IL). Int. J. Appl. Radiat. Isotop.; 25: No. 5, 237-238(May 1974).

A study has been made of target materials and target containers for use in the $^{79}Br(\alpha,2n)^{81}Rb$ reaction. The most stable to decomposition and chemical attack was found to be Cu_2Br_2 mounted on a metallic Cu target backing. Target preparation, irradiation, and chemical separation are described. The subsequent preparation of a ^{81m}Kr generator is given and tests carried out to detect impurities considered. (UK)

6185 SPALLATION PRODUCTION OF $^{127}Cs-^{129}Cs$ MIXTURES FOR MEDICAL USE. Scholz, K. L.; Sodd, V. J.; Blue, J. W. (Dept. of Health, Education, and Welfare, Cincinnati). Int. J. Appl. Radiat. Isotop.; 25: No. 5, 203-208(May 1974).

The feasibility of producing $^{127}Cs-^{129}Cs$ mixtures by spallation for use in nuclear medicine was investigated. It is possible to use this mixture since the energies of the principal γ-ray emissions of both 6 h ^{127}Cs and 32 h ^{129}Cs are similar. Chemical compounds of barium, lanthanum, cerium, praseodymium, and neodymium were irradiated with 590 MeV protons; and thin-target cross sections were determined for the formation of the desired ^{127}Cs and ^{129}Cs, and the unwanted contaminants ^{132}Cs and ^{136}Cs. Cross sections for the formation of ^{127}Cs, ^{129}Cs, ^{132}Cs, and ^{136}Cs from praseodymium, which gave the purest $^{127}Cs-^{129}Cs$ from the five targets irradiated, were 49 ± 8, 58 ± 8, 0.23 ± 0.06 and 0.011 ± 0.008 mbarn, respectively. The total $^{132}Cs-^{136}Cs$ contamination 24 h after the end of a typical irradiation was 0.08% of the $^{127}Cs-^{129}Cs$ activity. Ge(Li) spectra showed that the chemical procedure used quantitatively removed all non-cesium radioactive impurities. (auth)

6186 THALLIUM-204 SEALED SOURCES FROM A TARGET ACTIVATED IN THE EWA REACTOR. Poninski, M.; Czerwinski, A.; Smal, Z. (Instytut Badan Jadrowych, Swierk, Poland). Nukleonika; 19: No. 1, 41-46(1974). (In Polish).

A method of preparing beta radiation sealed sources by thallium electrodeposition on a copper foil was developed. Almost quantitative deposition of the metal from an electrolytic solution were gained. The radiation sources obtained have considerable beta particle output from the surface unit. (auth)

Reactor Fuel Reprocessing

Refer also to abstract 6596.

6187 (BARC-681) LABORATORY STUDIES ON ACID THOREX PROCESS. Srinivasan, N.; Balasubramanian, G. R.; Chitnis, R. T.; Venkateswaran, S.; Kulkarni, R. T. (Bhabha Atomic Research Centre, Bombay (India). Fuel Reprocessing Div.). 1973. 46p. Dep. NTIS (US Sales Only) $5.50.

Laboratory studies were undertaken to develop suitable flowsheet for the recovery of thorium and uranium from the irradiated thorium rods from CIRUS reactor using 30% TBP as solvent in aliphatic diluent. Study consists of collection of equilibrium data for thorium under various HNO_3 concentrations, evaluation of thorium concentrations for the extraction section, and collection of uranium stripping equilibrium data for different thorium concentrations. The third phase formation regions were found out. The extraction flowsheet consists of two extraction sections namely 0.42 and 2.7 M acid sections. There are dual scrub sections of 1 M acid and water. The thorium partitioning section consists of a thorium strip section and organic scrub section for uranium. There is final uranium strip section. Theoretical stage requirement for the entire flowsheet was evaluated by McCabe-Thiele diagrams and verified by counter current batch extraction. (auth)

6188 (BARC/I-135, pp 91-99) PROCESS CHEMISTRY OF NEPTUNIUM. Srinivasan, N.; Ramaniah, M. V.; Nadkarni, M. N.; Kumar, S. V.; Patil, S. K.; Ramakrishna, V. V.; Swarup, R.; Chadha, A.; Kartha, P. K. S.; Sonawane, R. R. (Bhabha Atomic Research Centre, Bombay). 1971.

Some aspects of process chemistry of neptunium were investigated with a view to arriving at optimum conditions for the recovery of ^{237}Np in fuel reprocessing. The aspects studied are: (1) oxidation state analysis of neptunium in the Purex Process feed solution, (2) effect of nitric acid and uranium concentration on the extraction of Np(IV) and Np(VI) into 30% TBP at 45 and 60°C, (3) countercurrent extraction of Np(IV) and Np(VI) under Purex Process conditions. The results of the study are discussed. (INIS)

6189 (BARC/I-229) PROGRAM FOR THE DEVELOPMENT OF CAPABILITIES FOR DESIGNING AND ANALYZING PROCESS CONTROLS. Britto, S. E. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 30p. INIS.

The need for development of capabilities in terms of facilities and expertise for designing and analyzing effective process control schemes for fuel reprocessing plants is pointed out. An outline of an organized program of activities for handling larger quantities of plutonium on commercial basis is described. The benefits of instrument controlled continuous operation of aqueous reprocessing system are discussed. The disadvantages of present

control method are indicated. The various interconnected activities to develop suitable closed loop systems of control such as theoretical analysis, experimental investigations, integration procedure etc. are described. (INIS)

6190 (ETR-270) CHEMICAL ASPECTS OF SOLVENT EXTRACTION ON PLANT SCALE AT EUROCHEMIC. van Geel, J.; Joseph, C.; Detilleux, E.; Heinz, W.; Centeno, J.; Gustafsson, B.; Marchant, Y. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Apr 1971. 22p. INIS.

From international solvent extraction conference ISEC 71; The Hague, Netherlands (19 Apr 1971).

Some chemical aspects in reprocessing fuel at Eurochemic from nuclear reactors by solvent extraction using 30% tributyl phosphate as extractant for uranium and plutonium are given. Application of uranous nitrate as reductant for plutonium in air pulsed columns, solvent stability and process performance under different radiation exposures, and formation of heavy phase and deposits under certain process conditions are discussed. (auth)

6191 (GERHTR-58) REPROCESSING OF THORIUM-BEARING NUCLEAR FUELS. Annual Report, July 1, 1971-June 30, 1972. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Chemische Technologie). Aug 1972. 128p. Dep. NTIS $8.50.

Work performed under United States-German High Temperature Reactor Research Exchange Program.

This research report is divided into the following main headings: combustion/TBP solvent extraction process (JUPITER test installation); formation and separation of radionuclides; material balance accountancy, including fissile material safeguards system; refabrication of THTR fuels; radioactive waste treatment and solidification; and the Chlorinex process. (LK)

6192 (JUL-1033-CT) ANALYSIS AND MATERIAL BALANCE IN THE REPROCESSING OF HTGR FUELS. Brodda, B. G.; Filss, P.; Kirchner, H.; Wenzel, U. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Dec 1973. 24p. (In German). Dep. NTIS (US Sales Only) $4.25.

For material balancing and fission process control in the reprocessing of AVR fuels, the process is divided into two material balance zones. The first zone comprises the head-end process (combustion of the spherically shaped fuels, waste gas purification, dissolving of the oxide combustion residues). Here, nondestructive measuring methods are used (counting and sorting processes, gamma spectrometrical burnup determinations). After combustion the weight of the oxide ash is determined. After it has been dissolved, the process solution is subjected to chemical and physical measuring procedures (in-line measurements of the heavy metal content by combined density and level measurement, x-ray fluorescence analysis, mass spectrometrical determination of the isotope composition of U and Pu, alpha spectrometrical determination of some actinide nuclides). The second zone begins with a solvent extraction of the process solution. Having passed through a series of mixer-settlers, the solution is separated into thorium, uranium products, and radioactive waste. Nitric acid distillate and an organic solution are obtained; they are purified and recycled. All process flows arising are controlled by the process control, mainly by combined density and level measuring. The more precise control of the fission material flow control and the material balancing are off-line. X-ray fluorescence analysis, potentiometric titrations, as well as alpha and mass spectrometry are used. The second MBZ ends with the drawing off into a receiver or transport vessel of the product solutions outside the shielding. (GE)

6193 (NP-19964, pp vp, Paper 15) NUCLEAR FUELS REPROCESSING, TRANSPORTATION, WASTE MANAGEMENT. Larson, H. J. 1973.

In seminar on the engineering aspects of siting and operating power plants.

The three areas in the nuclear fuel cycle are discussed: transportation of the fuel from the reactors and the transportation of the purified product to the core fabricators, reprocessing of the nuclear cores to extract the still fissionable uranium and plutonium, and finally the management and ultimate storage of the high-level waste products. (LCL)

6194 (ORNL-TM-3534) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR JULY 1971, No. 29. (Oak Ridge National Lab., Tenn. (USA)). Aug 1971. Contract W-7405-eng-26. 69p. AT.

This report is one of a series outlining progress in the development of methods for the reprocessing and fabrication of LMFBR fuels. Development work is reported on problems of irradiated fuel transport to the processing facility, the dissolution of the fuel and the chemical recovery of the PuO_2-UO_2 values, the containment of volatile fission products, product purification, conversion of fuel processing plant product nitrate solutions to solids suitable for shipping, fuel fabrication of sol-gel materials, and fuel evaluation studies, both in-pile and out-of-pile. Pertinent experimental results are presented for the information of those immediately concerned with the field. Detailed description of experimental work and data are included in topical reports and in the Chemical Technology Division and Metals and Ceramics Division Annual Reports. (auth)

6195 REPROCESSING OF SPENT FUEL AND DISPOSAL OF RADIOACTIVE WASTES. Nomi, M. (Ebara Mfg. Co. Ltd., Tokyo). FAPIG (Tokyo); No. 69, 42-47(May 1973). (In Japanese).

In Japan, fuel reprocessing will start from 1974. Then the problem of the disposal of radioactive wastes, especially high-level liquid, will arise, which are discharged from a reprocessing plant. Developments in this field in the U. S., West Germany and the U. K. in particular are described, concerning the solidification, storage and disposal of high-level liquid wastes. In the solidification, the objective aimed at is generally vitrification. For the disposal, no final solution is established yet; as intermediate, however, an engineered storage facility is being considered. In West Germany, studies are mainly performed at Karlsruhe, and in the U. K. at Harwell; while the ESF is investigated in Atlantic Richfield Hanford Company. (JA)

6196 MARCOULE PILOT PLANTS. Niezborala, F. (Centre de Marcoule, Bagnols-sur-Ceze, France). Bull. Inform. Sci. Tech. (Paris); No. 188, 17-26(Jan 1974). (In French).

The Marcoule Pilot Plant Service is concerned with: the development on a semi-industrial scale of irradiated fuel processing techniques together with techniques for recovering the sub-products contained; studies of the solidification of fission product solutions; the development of processes and methods for exploiting pilot solidification plants. The facilities available are described. (FR)

6197 IDENTIFICATION OF PYROLYSIS BY-PRODUCTS IN FLUIDIZED-BED SOOT AND PYROCARBON. Wolfrum, E.; Rottman, J.; Nickel, H. (Kernforschungsanlage, Juelich, Ger.). Z. Anal. Chem.; 268: No. 1, 19-25(Jan 1974). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Germany (2 Apr 1973).

In the frame of further development of fluidized bed coated particle fuel for high temperature reactors, both the pyrocarbon deposited on fuel kernels and the soot obtained besides, were investigated to their pyrolysis by-products. Aim of the study was to improve the understanding of the mechanisms in pyrocarbon deposition on fuel kernels during the thermal decomposition of lower hydrocarbons. This study was made on products formed in acetylene and propylene pyrolysis, the extraction being performed by various methods. The extracts were separated by gas-chromatographic and mass-spectrometric methods. Twenty-one polycyclic aromatic hydrocarbons could be identified in the soot. Beyond those the pyrocarbon contains polycycles of even higher molecular weights. (GE)

CONTROLLED THERMONUCLEAR RESEARCH

6198 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 8, No. 4, 1974. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 51p.

Confinement and Heating

Refer also to abstracts 6261, 6275, 6276, 6287, and 6321.

6199 (UPee-73-04) LOWER HYBRID RESONANCE PLASMA HEATING. Brambilla, M. (Padua Univ. (Italy). Istituto di Elettrotecnica e di Elettronica). Apr 1973. 12p. INIS.

Some fundamental features of the hf plasma heating method, based on the lower hybrid resonance, are outlined. Basic theoretical aspects of the wave propagation near the lower hybrid resonance and the accessibility problem are reviewed. The behavior of the electric field in the resonant region is also considered. (INIS)

6200 GENERATING AND CONFINEMENT OF HIGH-ENERGY PLASMAS. Abstract. Fuenfer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1972). vp. (In German).

From information meeting of the Max-Planck-Institut fuer Plasmaphysik; Garching, Germany (7 Nov 1972).

In linear experiments with high-β-plasmas important data with respect to the fusion process could be obtained, namely temperatures of about 100 million degrees at high pressures (ca. 10^{16} cm^{-3}) and at high β values (β almost 1). For further investigations into these problems, the high voltage theta pinch is used with a maximum voltage of 500 kV. It has already been possible to obtain temperatures of about 200 million degrees, with the plasma densities being rather small, however. Therefore, a series of experiments has been started to investigate the confinement of high-β-plasmas in closed (toroidal) arrangements, using the approved heating methods. Especially two configurations, i.e., the high-beta stellarator and the screw pinch and its modification, the belt pinch, are investigated. In the screw pinch, a strong current flows through the plasma in longitudinal direction. Its magnetic field produces a toroidal equilibrium. The plasma, however, is unstable and thus collapses within a very short period of time. By changing the circular cross section in the screw pinch and producing a plasma with an oblong cross section, the plasma will remain stable over the period of time available for observation. Such experiments have been made with ISAR IV. However, only relatively low temperatures of about 200,000 degrees could be reached. Hence the confinement time was only 1/10,000 sec, as at such temperatures the confining magnetic field penetrates relatively quickly into the plasma. Experiments in the high-beta stellarator ISAR T1 are carried out to obtain an equilibrium without toroidal currents in the plasma. This is attempted by producing magnetic fields by means of helically shaped external conductors surrounding the plasma which bring the plasma into such a shape that, according to theoretical considerations, it can be expected to obtain equilibrium. These complicated fields induce a helical deformation of the plasma and also a deformation of the plasma surface. (GE)

6201 STOCHASTIC HEATING OF PLASMA ELECTRONS USING MICROWAVE NOISE. Puri, S. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 16: No. 6, 517-526(Jun 1974).

A mirror-contained hydrogen plasma of approximately 10^{11} cm^{-3} density and 1 keV temperature was produced using 100 W broadband microwave noise at the electron cyclotron resonance. In contrast to the single frequency heating, noise heating generated a stable, reproducible plasma more efficiently. The use of Ioffe bars was found to be indispensable in suppressing the low-frequency instabilities and the attendant plasma loss, as well as for assuring reproducibility. Detailed measurements of the density, diamagnetic and energy analyzer measurements were presented for several values of power input, noise bandwidth, and gas pressure. Independent measurements of density and diamagnetic signal decay in the afterglow plasma were also given. (auth)

6202 CRITERION FOR THE REVERSIBILITY OF THE MOTION OF PLASMA DURING THE REFLECTION BY A COMBINED HF AND MAGNETOSTATIC MIRROR AT ECR. Golovanivskii, K. S.; Milantiev, V. P. (Patrice Lumumba Univ., Moscow). Plasma Phys.; 16: No. 6, 549-551(Jun 1974).

In the trapping of high-temperature plasma with the help of a combined hf-magnetostatic mirror under conditions of electron-cyclotron resonance (ECR) the question of reversibility of the motion is of special interest. The problem of what fraction of energy gained by the plasma during the original passage through the resonance region is lost when the plasma passes through the resonance region for a second time after reflection is examined. (UK)

6203 TRANSPORT OF CHEMICALLY HEATED PLASMA IN THE JIPP STELLARATOR. Yatsu, K.; Kawahata, K.; Fujimara, M.; Kawasumi, Y.; Miyamoto, K. (Nagoya Univ., Japan). Plasma Phys.; 16: No. 6, 531-556(Jun 1974).

Experimental results of plasma transport of ohmically heated plasma in an $l = 3$ circular stellarator were described. The plasma current decreased when the rotational transform angle near the plasma boundary due to the stellarator field and the plasma current was rational. Similar phenomena were observed in the experiments of ohmic heating in the $l = 2$ stellarator of Wendelstein IIb (Grieger, G. et al, (1973) Plasma Phys. 15, 151). The resonant loss was previously observed in the confinement experiments in Wendelstein IIa (Berkl, E. et al, (1969) Plasma Physics and Controlled Nuclear Fusion Research, Vol. I, p. 513, IAEA, Vienna), Tor I (Ivanovsky, M. A. et al, (1971) Plasma Physics and Controlled Nuclear Fusion Research, Vol. III, p. 63, IAEA, Vienna) and the C-stellarator (Sinclair, R. M. et al (1965) Phys. Fluids 8, 118). The measurements of potential distributions over the plasma cross section show that strong convective motions occur in the rational cases. (auth)

6204 HEATING OF A LORENTZ PLASMA IN AN ELECTRICAL FIELD. Kostritsa, A. A.; Savel'ev, V. L. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 48-53(1973). (In Russian).

The method for the determination of function moments, satisfying the linear transfer equation and taking into consideration the motion of the atom-scatter, was extended to a system of kinetic equations. On the basis of a precise corollary from the system of kinetic equations the reverse effect of heating the gas by an electrical field on the velocity distribution of electrons was studied. (tr-auth)

6205 INTERACTION OF PARTICLES TRAPPED IN A MAGNETIC FIELD WITH COHERENT ELECTROSTATIC WAVES. Dobrowolny, M.; Orefice, A.; Pozzoli, R. (European Space Research Inst., Frascati, Italy). Plasma Phys.; 16: No. 5, 479-482 (May 1974). (In French).

The study of effects of electrostatic waves on the motion of particles trapped in magnetic wells is of interest in relation to the problem of stationary plasma confinement in toroidal geometries, owing to the numerous consequences of the presence of trapped particles both for the equilibrium and the stability properties of the plasma. One example for particle trapping in electrostatic waves is discussed. (UK)

6206 STELLARATORS. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 1-136(1973). (In Russian).

The papers in this collection are concerned with the results of theoretical and experimental research on containment of a high-temperature plasma in the toroidal magnetic traps "Liven'-1" and "Tor-2" in which a stellarator magnetic field is set up, i.e., a field formed by external currents and having rotational conversion. The collection contains research on calculating and creating the necessary configuration of the magnetic field and also numerous applied papers dealing with the procedure of studying plasma. (Referativnyi Zh.)

6207 CONCERNING A GOVERNING PRINCIPLE OF PLASMA DIFFUSION IN STELLARATORS. Shpigel, I. S. (Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 5-10(1973). (In Russian).

Within the framework of the present conception of the collision mechanism of plasma diffusion in toroidal systems, an analysis is made of a number of published experiments on plasma containment in stellarators. Calculations of diffusion conditions made on the basis of the theory showed that in the cases analyzed there should be an actual observable experimental linear relation between the time of plasma containment and the rotational conversion angle of a line of force of the magnetic field. (Referativnyi Zh.)

6208 TRANSVERSE HEATING OF A COLD DENSE HELIUM PLASMA BY A PULSED CO_2 LASER BEAM. Décoste, R.; Engelhardt, A.G.; Fuchs, V.; Neufeld, C.R. (Direction Sciences de base, Institut de recherche de l'Hydro-Québec, C.P. 1000, Varennes, Québec JOL 2PO, Canada). J. Appl. Phys. 45: No. 3, 1127-1134 (Mar 1974).

We present experimental evidence for the transverse heating of a dense (3.2×10^{17} cm^{-3}) cold ($\simeq$4 eV) helium Θ-pinch plasma by the focused beam of a TEA CO_2 laser having a pulse duration of 180 nsec and a peak power of approximately 5 MW. The laser light was incident on the plasma during the first pinch compression, when streak photographs taken with a high-speed camera indicate a stable quiescent plasma lasting about 1.5 μsec. Time-resolved spectroscopic measurements were made to determine the plasma density and temperature before and after irradiation by the CO_2 laser. Maximum temperature increases of 0.8 eV and density increases of 0.5×10^{17} cm^{-3} were observed for a laser energy of 0.7 J incident on the plasma. The theoretical description of the interaction considers the quasistatic temporal response of the plasma to the absorption of laser energy by inverse bremsstrahlung, and includes deviations from local thermodynamic equilibrium (LTE) before, during, and after irradiation. The absorbed energy is consumed in expansion, heating, and further ionization of the plasma. Highly excited atomic or ionic states are assumed to be in Saha equilibrium with each other and with the ionization continuum, whereas the ground states of successive ionization stages are assumed to be in coronal equilibrium. Thermal conduction losses are negligiqle. The theory correctly predicts the observed temperature increases but not the observed density changes, since inertial effects are neglected in order to render the model tractable. (auth)

6209 RADIATION-LIMITED MODEL FOR A PLASMA CONDUCTION LAYER IN MAGNETIC FLUX COMPRESSION SYSTEMS. Turchi, P.J. (Naval Research Laboratory, Washington, D. C. 20375). J. Appl. Phys. 45: No. 3, 1100-1104 (Mar 1974).

The nature of a high-temperature plasma layer adjacent to a vaporizing conductor surface in multimegagauss flux compression systems is of interest in terms of the maximum field levels attainable and the extent to which high-Z conductor impurities will contaminate plasmas confined by ultrahigh magnetic fields. A model has been developed for such a conductor plasma layer, based on the assumption of a steady balance between resistive heating and radiation loss at any location within the plasma layer. A general analytical solution is found for the magnetic field distribution through the layer in terms of plasma and conductor properties and a nondimensionalized profile integral. Criteria are derived emphasizing the need for proper dynamic operation if plasma conduction layers are to have any importance in high-field flux compression systems. (auth)

6210 ION ENERGY CONTAINMENT IN THE OAK RIDGE TOKAMAK. Berry, L.A.; Clarke, J.F.; Hogan, J.T. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. Lett. 32: No. 7, 362-365 (18 Feb 1974).

The ORMAK (Oak Ridge tokamak) experiment gives the first extensive measurement of ion transport in a collisionless plasma. We find a transition from neutral domination to a thermal-conduction limit as the ratio of central electron density to central neutral density varies by an order of magnitude. The results agree with neoclassical predictions of ion thermal transport throughout the whole range. (auth)

6211 SYMMETRY OF LASER-DRIVEN IMPLOSIONS. Henderson, D.B.; Morse, R.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. Lett. 32: No. 7, 355-358 (18 Feb 1974).

A perturbation method is developed for nearly spherical heat and fluid flow. It shows that electron thermal conduction may be sufficiently symmetrizing to allow laser-driven fusion with a single beam. (auth)

6212 RESTRAINING OF RUNAWAY ELECTRONS IN HIGH-TEMPERATURE PLASMAS. Coppi, B. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. Lett. 32: No. 10, 530-534 (11 Mar 1974).

A theoretical model is proposed in relation with the observed lack of electron runaway processes in magnetically confined, high-electron-temperature plasmas on which electric fields of the order of or larger than the critical runaway field have been applied. The excitation of standing modes locked in with the periodic inhomogeneities of the magnetic field is considered in order to provide, via mode-particle resonance processes, a momentum exchange between the (accelerated) current-carrying electrons and the magnetic field itself. (auth)

6213 ION TEMPERATURE IN OHMIC HEATING IN THE URAGAN STELLARATOR. Konovalov, V.G.; Kravchin, B.V.; Pavlichenko, O.S. Sov. Phys.-Tech. Phys. 18: No. 6, 746-748 (Dec 1973).

The ion temperature is determined from the width of the He II 4686 Å line with a scanning Fabry-Perot interferometer in an ohmic discharge in the Uragan stellerator. Typical values are $T_i\simeq$15-30 eV. Ion energy lifetimes $(\tau'_E)_{exp}\simeq$0.4-0.6 msec are found from the energy-balance equation. A comparison is made with the theoretical values $(\tau'_E)_{theo}$ for the corresponding conditions; qualitative agreement is found between the behavior of $(\tau'_E)_{exp}$ and the predictions of neoclassical theory, but the experimental values are about an order of magnitude smaller than the theoretical values. This discrepancy is attributed to the uncertainty in the radial distributions of the parameters in the ion energy-balance equation. (auth)

6214 NEUTRAL-BEAM HEATING IN THE ADIABATIC TOROIDAL COMPRESSOR. Bol, K.; Cecchi, J.L.; Daughney, C.C.; Ellis, R.A. Jr.; Eubank, H.P.; Furth, H.P.; Goldston, R.J.; Hsuan, H.; Jacobsen, R.A.; Mazzucato, E.; Smith, R.R.; Stix, T.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 32: No. 12, 661-664 (25 Mar 1974).

Experiments have been conducted on an adiabatic toroidal compressor with tangential injection of two 14-15-keV, 3-4-A beams of H^0 or D^0. The ion-temperature rise for both H^+ and D^+ plasmas is 70-80 eV (i.e., 35-40%), consistent with theoretical expectations for charge-exchange-limited energy transport at neutral-atom densities $\simeq10^9$ cm^{-3}. The injected ions are found to decelerate in agreement with classical theory and produce an initial plasma ion heating rate of $\sim$20 keV/sec. (auth)

6215 PRESSURE-BALANCE LIMITATIONS IN Z PINCHES WITH DIFFUSION HEATING. Baker, D.A.; Phillips, J.A. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. Lett. 32: No. 5, 202-205 (4 Feb 1974).

Conditions of global energy and pressure balance are applied to a cylindrically symmetric plasma column having a B_θ confining field and a B_z stabilizing field, as exist in stabilized z pinches and tokamaks. In the process of producing stable contributions the plasma pressure due to Ohmic heating during magnetic field diffusion may become too large for the confining field to contain. (auth)

6216 CO_2 LASER HEATING OF A MAGNETIZED PLASMA COLUMN. Molen, G.M.; Kristiansen, M.; Hatler, M.O. (Plasma Laboratory, Department of Electrical Engineering, Texas Tech University, Lubbock, Texas 79409); Bengtson, R.D. Appl. Phys. Lett. 24: No. 12, 583-586 (15 June 1974).

A 280-cm^3 volume of a magnetized plasma column has been heated by a 15-J CO_2 TEA laser. The 2-eV plasma with peak electron densities of 3×10^{16} cm^{-3} was axially irradiated by the collimated unfocused laser beam. A measured temperature increase of approximately 0.5 eV was found to be in excellent agreement with classical absorption by inverse bremsstrahlung. A significant increase in heating was observed using a multipass heating scheme. (auth)

Diagnostics

Refer also to abstracts 6259 and 6347.

6217 (CEA-CONF-2458) VARIABLE MAGNIFICATION SPECTROMETER. Clement, M.; Moulin, B.; Pinet, D.; Stevenin, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). [nd] 4p. (CONF-730906-14). Dep. NTIS (U.S. Sales Only) $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

A new high speed spectrometer was designed for the measurement of line profiles emitted by short living plasmas (Doppler broadening, for example). This spectrometer, with a Fabry-Perot as a disperser, presents the essential advantage of possessing an electronic spectral scanning, without any mechanical elements. It has the luminosity and resolution properties of other interferential spectrometers. (auth)

6218 (FRNC-TH-451) MEASUREMENT OF THE ELECTRON DISTRIBUTION FUNCTION IN AN IONIZED Cs VAPOR. Bourdier, A. (Paris-11 Univ., 91-Orsay (France)). 1972. 110p. (In French). Dep. NTIS (U.S. Sales Only) $6.50.

Thesis.

A second derivative Langmuir probe method was used to measure the electron distribution function of an ionized Cs vapor. It is shown that the systematic error due to the ion contribution is negligible in the domain studied. The neutral atom density was measured (10^{15} cm^{-3}) together with the electron density (10^{13} cm^{-3} to 10^{10} cm^{-3}). The distribution function obtained is Maxwellian up to 2.2 eV ($n_e \geq 2\times10^{11}$ cm^{-3}) thus justifying the Sayer hypothesis in this domain. The distribution functions are Maxwellian between 1.4 and 1.5 eV for small densities. As the energy increases, the deviation from the Maxwellian distribution becomes larger. This fact is in agreement with the results of Postma and the theoretical model developed by Archambault. Comparisons made between the experimental results and those obtained using this model indicate that volume phenomena are sufficient to qualitatively explain the experimental results above $n_e = 10^{11}$ cm^{-3}; below this value, the disagreement can be explained by taking into account the ambipolar scattering. The complete calculation was not, however, performed. (FR)

6219 (JPRS-61878) DIAGNOSTICS OF DENSE LASER PLASMAS AND SUPERDENSE HOT PLASMAS. (AN SSSR, Mos-

cow. Fizicheskij Inst.). 1 May 1974. Translation of Preprints No. 145 and No. 173. 33p. NTIS.

Methods are described for determining the temperature and density of plasma produced by the sharp focusing of a laser beam onto the surface of a condensed material, and diagnostics of hot and very dense laser-produced plasmas. (auth)

6220 (JPRS-61878, pp 17-33) SPECTROSCOPIC METHODS FOR DIAGNOSTICS OF SUPERDENSE HOT PLASMAS. Vinogradov, A. V.; Sobelman, I. I.; Yukov, E. A. (Lebedev Inst. of Physics, Moscow). 1 May 1974. Translation of Preprint No. 173.

The problem of diagnostics of hot and very dense laser-produced plasmas is discussed. The parameters of plasmas under consideration are: $T_e \sim 0.1$ to 10 keV, $N_e \sim 10^{21}$ to 10^{26}. It is shown that different spectroscopic methods can be used for plasma density measurements: from line profiles and intensities in x-ray spectra $\lambda \sim 1$ to 10 Å, emitted by ions with charge r = 10 to 30. (auth)

6221 (UCID-16496) ELECTRON TEMPERATURE IN THE BASEBALL DISCHARGE: PRELIMINARY RESULTS AND ANALYSIS. Hooper, E. B. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 May 1974. Contract W-7405-eng-48. 13p. Dep. NTIS $4.00.

First laser scattering results on the Baseball discharge target indicate $T_e = 5$ eV. These results are discussed from the viewpoint of the discharge power balance. (auth)

6222 DETERMINATION OF THE ELECTRON TEMPERATURE OF A SHOCKTUNNEL-PRODUCED Ar–Cs PLASMA BY THE LINE REVERSAL METHOD USING NON-RESONANCE LINES OF Cs. van Ooyen, M. H. F.; Houben, J. W. M. A. (Technische Hogeschool, Eindhoven, Netherlands). J. Quant. Spectrosc. Radiative Transfer; 14: No. 6, 395-403(Jun 1974).

It is shown that the influence of the temperature boundary layer on the measured population temperature of Cs, of a shocktunnel-produced, low-temperature Ar–Cs plasma, can be neglected in measurements where the line reversal method is used with non-resonance lines of Cs. Owing to Ar–Cs collisions and radiation losses, a decrease in population density of the levels concerned in the transition occurs. This decrease is calculated in comparison with LTE and results in a population temperature of Cs which is less than 8 percent lower than the electron temperature. Because of a test time of 5 msec in the shocktunnel experiment, use is made of a chopper to measure the radiation intensity of the plasma and the radiation intensity of the reference source in interaction with the plasma alternately. From these two radiation intensities and the radiation intensity of the reference source, is calculated the population temperature and the ratio of the concentration of Cs-atoms and the concentration of Ar-atoms, which is called the seed ratio. Comparison of the measured population temperature and the calculated electron temperature at a gas temperature and pressure of 2000°K and 5 atm, respectively, shows agreement within 10 percent. (auth)

6223 SPECTROSCOPIC AND PROBE MEASUREMENTS OF EXCITED STATE AND ELECTRON DENSITIES IN RADIATION INDUCED PLASMAS. Thiess, P. E.; Miley, G. H. (Univ. of Illinois, Urbana). pp 90-98 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Measurements of excited state and electron densities in noble and atmospheric gas plasmas created by intense sources of nuclear radiation were made. A ½ Ci, ^{210}Po alpha particle (5.3 MeV He^{++}) source with a flux of 10^7 ions/cm^2-sec was used to irradiate cylindrical volumes of both single gases and gas mixtures. Data obtained on He, Ne, Ar, He–N_2, and He–Ne indicate that for pressures above 10 torr resonant transfer, collisional mixing, charge exchange, and molecular ion formation are important plasma kinetic processes along with Penning ionization and superelastic collisions which destroy metastable states. Studies of the effect of a superimposed electric field on excited state and electron densities indicate that a field of between 1 and 10 Volts/cm-torr tends toward optimum excited state production. (auth)

6224 USE OF EMISSIVE PROBES IN PLASMA DENSITY MEASUREMENTS. Schuss, J. J. (Massachusetts Inst. of Tech., Cambridge). pp 176-179 of NEREM 72. Newton, MA; Institute of Electrical and Electronics Engineers, Inc. (1972).

From northeast electronics research and engineering meeting; Boston, MA (30 Oct 1972).

A theoretical model for the variation of hot-probe current when the probe is biased negative of the plasma potential is developed, and it is shown that the electron-emitting plasma probe can be used to determine the plasma density or the electron temperature when either value is known. Supporting experiments are described, and it is concluded that the emissive probe should be useful in plasma density measurements, possibly up to densities of 10^{11}/cm^3. The greatest advantage of these probes is at low densities where they emit a large (easily measured) current into the plasma while the collected current of a cold probe may be quite small. (IAA)

6225 MEASUREMENT OF THE ION TEMPERATURE IN THE DENSE PLASMA FOCUS BY LASER BEAM SCATTERING. Forrest, M. J.; Peacock, N. J. (United Kingdom Atomic Energy Research, Abingdon, Eng.). Plasma Phys.; 16: No. 6, 489-498 (Jun 1974).

The spectrum of scattered ruby laser light due to collective electron motion was used to measure the ion temperature in the dense plasma focus. Over a range of operating conditions the deuterium temperature in the dense pinch was between 0.7 and 3 keV, the highest values being obtained on only a few discharges in pure deuterium. Interpretation of the scattered light in terms of a near-thermal plasma was favored for the dense pinch for two reasons. Firstly, the electron parameters derived from the scattered spectrum were in agreement with other independent measurements and secondly, the contribution to the spectrum by rare gas ions in the plasma could be quantitatively accounted for. (auth)

6226 ELECTRON TEMPERATURE MEASUREMENTS IN A DENSE PLASMA USING BERNSTEIN WAVES. Christopoules, C.; Christiansen, P. J. (Univ. of Sussex, Eng.). Plasma Phys.; 16: No. 6, 499-507(Jun 1974).

Bernstein (electron cyclotron) waves were successfully excited and detected in a fairly dense rf Argon plasma. The use of these waves as a diagnostic tool in studying the thermal properties of the plasma in the direction perpendicular to an applied magnetic field was investigated. The method could be useful in probing a wide variety of laboratory plasmas. (auth)

6227 OBSERVATIONS OF ELECTRON TEMPERATURE RELAXATION RATES IN RARE GAS AFTERGLOW PLASMAS. Dean, A. G.; Smith, D.; Adams, N. G. (Birmingham Univ., Eng.). J. Phys., B (London); 7: No. 5, 644-656(1 Apr 1974).

The single Langmuir probe technique was used to determine the relaxation rates of the electron temperature, T_e, in repetitively produced, time-resolved afterglow plasmas. Comprehensive data is presented for krypton plasmas together with a preliminary data for neon and argon plasmas. The electron temperature cooling curves for a given gas pressure, ρ_0, have been interpreted in terms of a characteristic time, τ_{en}, for electron cooling via electron-neutral collisions. Spatial measurements of T_e indicated that no significant T_e gradients exist in the plasmas during the periods over which cooling curves were obtained; it is also argued that there was no significant elevation of the gas temperature above the wall temperature during the afterglow. Hence the interpretations of the cooling curves were greatly simplified. In krypton, the product $\tau_{en}\,\rho_0$ was found to be constant for 1300 K > T_e > 300 K with a value of $(9.7 \pm 0.6) \times 10^{-5}$ s torr. The results for neon and argon yielded approximate values for $\tau_{en}\,\rho_0$ of 3.5×10^{-4} s torr (450 K > T_e > 300 K) and 1.35×10^{-4} s torr (400 K > T_e > 180 K) respectively. On the basis of a simple classical theory, the $\tau_{en}\,\rho_0$ values have been interpreted in terms of the momentum transfer cross section, σ, which for krypton was found to be electron temperature dependent, thus $\sigma = (2.65 \pm 0.35) \times 10^{-14}\,T_e^{-\frac{1}{2}}$ (1300 K > T_e > 300 K) giving a value of 1.55×10^{-15} cm^2 at 300 K. The values of σ at 300 K are $\approx 5 \times 10^{-17}$ cm^2 for argon and $\approx 9 \times 10^{-17}$ cm^2 for neon. In all three gases good agreement is obtained with previously published data. (auth)

6228 ALTERNATING-CURRENT LANGMUIR PROBE IN A HIGH-PRESSURE FLOWING PLASMA. Smy, P. R. (Univ. of Alberta, Edmonton). J. Phys., D (London); 7: No. 6, 856-865 (11 Apr 1974).

The ac impedance was measured of a Langmuir probe immersed in a high-pressure flowing plasma. For the common situation where the plasma sheath is thick compared with the hydrodynamic boundary layer, but thin compared with the probe radius, the probe is found to behave as a parallel combination of a resistance and a capacitance. Both resistance and capacitance vary with frequency in the manner predicted by theory, and the variation of the former quantity appears to offer a simple method of measuring flow velocity. (auth)

6229 AN x-RAY SPECTRAL MEASUREMENT SYSTEM FOR NANOSECOND PLASMAS. Johnson, D.J. (Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico). Rev. Sci. Instrum. 45: No. 2, 191-194 (Feb 1974).

A 15-channel Ross filter/silicon diode detection system has been developed for measuring nanosecond pulsed x-ray spectra in the energy range from 4.5 to 116 keV. The theory and practical aspects of Ross filters and silicon diode detectors are discussed as applied to this

system. The data read-out system consists of a current integrator array, a simultaneous multichannel digital voltmeter, and oscilloscopes. The system is designed for compatibility with a small computer to allow real time spectral measurements. The x-ray spectrum of a 24 kJ dense plasma focus has been obtained with this system and a theoretical thick target electron beam x-ray spectrum fit to the experimental data. The best fit is obtained with an E^{-2} power law electron beam spectrum extending from 5 to 125 keV. (auth)

6230 A "PLASMASCOPE" USING LIGHT EMITTER DIODES. Ejima, S.; Novinski, A.; Marshall, T.C. (Plasma Laboratory, Columbia University, New York, New York 10027). Rev. Sci. Instrum. 45: No. 1, 57-59 (Jan 1974).

A "plasmascope" device which permits visual display of the floating potentials from a 7 × 7 matrix of Langmuir probes immersed in a low-density plasma is described. The probe potential, which is proportional to the plasma space potential, is sampled through a high impedance FET circuit. These potentials are displayed by a matrix of light emitter diodes such that the light intensity at a point on the matrix is proportional to the corresponding probe floating potential. This device is useful to determine the qualitative location of the plasma, its configuration, and slow motion. (auth)

6231 MICROWAVE METHODS OF MEASURING DENSITY AND PLASMA ON THE STELLARATORS AT THE PHYSICS INSTITUTE IMENI LEBEDEV. Akulina, D. K.; Nechaev, Yu. I. (Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 99-133(1973). (In Russian).

A survey is given of microwave methods for measuring plasma density on stellarators at the Physics Institute imeni Lebedev. A microwave interferometer with electron phase shifting developed on the basis of a traveling-wave tube in the 3-cm band is described. Considered are resonator methods of measuring plasma density which use the metal chamber of the stellarator as a cavity with excitation of fundamental (10-cm) and high-frequency (8-mm) wave modes. The range of density measurement is $n = 10^9$ to 10^{11} cm^{-3}. A Fabry–Perot microwave resonator with a wave band of 4 mm designed for measuring density at $n = 10$ to 10^{13} cm^{-3} is described. The way that the magnetic field of the stellarator affects density measurement by resonator methods is discussed. (Referativnyi Zh.)

6232 ELECTROSTATIC PROBE MEASUREMENTS ON THE L-1 STELLARATOR. Berezhetskii, M. S.; Grebenshchikov, S. E.; Kossyi, I. A.; Sbitnikova, I. S.; Shpigel, I. S. (Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 82-99(1973). (In Russian).

Methods are described for using electrostatic probes to measure the parameters of a plasma injected into the L-1 stellarator by a spark source. Isolated Langmuir probes, an emitting probe, a multigrid electrostatic probe, and double probes were used to measure the plasma potential, electron temperature, ion temperature, ion concentration, fluctuating ion flow to the wall of the chamber, and quasiconstant ion fluxes. The probe designs and electrical measurement setup are described, and the possibilities of the probe method under conditions typical for the L-1 stellarator are discussed. A brief review is given of the principal results of measurements. (Referativnyi Zh.)

6233 FLOATING POTENTIAL OF A LANGMUIR PROBE IN A HIGH-PRESSURE PLASMA. Clements, R. M. (Univ. of Victoria, B.C.); Smy, P. R. J. Phys., D (London); 7: No. 4, 551-562(1 Mar 1974).

The floating potential (ie the potential assumed by a probe when the net current collected by it is zero) of a spherical electrostatic (Langmuir) probe in a collision-dominated plasma is investigated. The plasma is considered to be either static or flowing at subsonic velocities. The experimentally realistic situation is also considered where the probe is cold compared with the bulk plasma. The two extreme probe temperature conditions are discussed: that in which the electrons remain at their uncooled temperature, characteristic of the bulk plasma; and that in which they cool to the temperature of the neutrals near the probe. It is concluded that only in the case when the electrons cool and the sheath is thin does the floating potential vary appreciably from its value obtained in the absence of thermal gradients and thermoelectric effects. Experimental results are presented which support the concept that, for the opposite of the above condition (ie uncooled electrons, thick sheath), the floating potential is unaffected. In addition, the data have also been analyzed in a manner suggested by Lam (AIAAJ.; 3: 842-8 (1965)) to yield an accurate value for the electron temperature. (auth)

6234 ORIFICE PROBE FOR PLASMA DIAGNOSTICS. III. Experimental Considerations. Prokopenko, S. M. L.; LaFramboise, J. G.; Goodings, J. M. (Univ. of Quebec). J. Phys., D (London); 7: No. 4, 563-568(1 Mar 1974).

Experimental methods are presented for the detection and elimination of instrumental effects arising from field penetration and space charge for an orifice probe in low-pressure ($<2 \times 10^{-2}$ torr) rf discharge plasmas in argon. A channel orifice, compared with a sharp-edged orifice, provides number density values which are too low. The creation of a dual-peak ion distribution by the insertion of a grid into the plasma is illustrated. (auth)

6235 INJECTION OF SMALL MACROSCOPIC PARTICLES INTO PLASMAS AS A DIAGNOSTIC TECHNIQUE. Anestos, T.C.; Hendricks, C.D. (University of Illinois, Urbana-Champaign, Illinois 61801). J. Appl. Phys. 45: No. 3, 1176-1178 (Mar 1974).

A method is presented for the determination of electron temperature of plasma by the measurement of the charge acquired by a small spherical macroscopic particle of the order of 20-25 μ in diameter as it travels through the plasma. The particles are generated by the electromechanical breakup of a liquid jet. A theoretical relation between the electron temperature and the particle charge is derived which allows the determination of the electron temperature after the charge of the particle is measured experimentally. Measurements of the electron temperature in argon and helium plasmas are done, and comparisons with Langmuir probe measurements show good agreement. (auth)

6236 DIAGNOSTICS OF A GAS-DISCHARGE PLASMA WITH RESPECT TO THE ROTATION OF THE PLANE OF POLARIZATION OF SUBMILLIMETER LASER RADIATION. Kolerov, A.N.; Kutovoi, V.D.; Petrov, G.D. (All-Union Scientific-Research Institute of Engineering-Physics and Radioengineering Measurements.). High Temp. 11: No. 3, 589-591 (Jan 1974).

An attempt is made to determine electron concentration from the rotation of the plane of polarization, and the collision frequency from damping of SBM radiation. (AIP)

6237 USE OF NONSELF-REVERSED LINE PROFILES FOR PLASMA DIAGNOSTICS IN THE BURNER OF A METAL-HALOID LAMP. Kirpichnikova, L.A.; Krylova, S.I.; Luizova, L.A.; Nekrylova, I.M.; Solyanikova, V.A.; Khakhaev, A.D. Opt. Spectrosc. (USSR) 35: No. 5, 470-471 (Nov 1973).

An investigation is made into the widths of the nonself-reversed profiles of several spectral lines in the burner of a metal-haloid lamp; the lines were recorded with time, spectral, and spatial resolution. The reasons for the broadening of these lines are analyzed and the possibility of using them to determine some plasma parameters of a metal-haloid lamp is considered. The concentration of normal mercury atoms and the radial distribution of electron density are determined while the lamp is operating. (auth)

6238 DETERMINATION OF ELECTRON CONCENTRATION AND TEMPERATURE USING ABSOLUTE INTENSITIES OF SPECTRAL LINES IN A NONEQUILIBRIUM PLASMA. Vorobev, V.S.; Zheleznyak, M.B. Opt. Spectrosc. (USSR) 35: No. 4, 361-364 (Oct 1973).

The relation associating the populations of three excited states, the kinetics of the transitions between which are determined by collisions with electrons, is established on the basis of a modified diffusion approximation. These relations determine the electron temperature and concentration by measuring the absolute intensity of three spectral lines in a nonequilibrium plasma. It was demonstrated that in some papers the electron temperature was determined incorrectly in the recombined plasma. The correctly determined values eliminate the discrepancy between the calculated and experimental values of the coefficient of recombination of an argon plasma at atmospheric pressure. (auth)

6239 USE OF A FLOATING PROBE TO OBSERVE POTENTIAL OSCILLATIONS IN A PLASMA. Yushmanov, E.E. (I. V. Kurchatov Institute of Atomic Energy, Moscow). Sov. Phys.-Tech. Phys. 18: No. 5, 690-692 (Nov 1973).

A floating probe has certain advantages over a probe held at a fixed potential: Direct measurements can be made of the absolute oscillating potential; changes in the plasma density and slow temeprature changes have no effect on the measurements; the oscillation spectrum is reproduced correctly; and there is no high-frequency falloff due to time delay in the response of the probe sheath. A condition is derived for the resistance in the probe circuit required for operation of a floating probe. A lower limit on the density is found for operation of a floating probe ($n = 10^6$ cm^{-3}), and an upper limit is found on the frequency (the gigahertz range). The results remain approximately valid for a magnetized plasma. (auth)

6240 USE OF BREMSSTRAHLUNG CERENKOV DETECTORS TO MEASURE THE ENERGY OF PLASMA ELECTRONS. Volkov, Y.F.; Mitina, N.I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 5, 693-695 (Nov 1973).

A method is proposed for determining the energy of electrons from the signals from two Cerenkov detectors or scintillation detectors using calculated curves.

6241 POSSIBLE USE OF THE ADIABATIC COMPRESSION METHOD TO INVESTIGATE A CESIUM PLASMA. Kunavin, A.T.;

Asinovskii, É.I.; Kirillin, A.V.; Korshunov, Y.S. (High-Temperature Institute, Academy of Sciences of the USSR). High Temp. 11: No. 2, 226-230 (Nov 1973).

The adiabatic compression method is proposed for studying the P-v-T dependence of a cesium plasma at pressures of 10 to 300 atm and temperatures of 1000 to 4000°C. An adiabatic facility with an unloaded working piston has been created which allows investigation of the vapor of substances which are in the condensed state under normal conditions. Experiments with water vapor as a model have been conducted. (auth)

6242 PROPERTIES OF A DIELECTRIC-ROD WAVEGUIDE IMMERSED IN PLASMA. Maiti, J.N.; Basu, J. (Saha Institute of Nuclear Physics, Calcutta, India). J. Appl. Phys. 45: No. 4, 1650-1656 (Apr 1974).

The paper presents a study of various aspects of propagation in the TM_{01} mode along a dielectric-rod waveguide immersed in plasma. Expressions are derived and characteristics obtained for the dispersion relation, phase and group velocities, as well as power flow in and around the guide in the loss-free case of propagation. The dispersion relation reveals that the TM_{01} mode is the dominant one with backward wave characteristics for low negative values of ϵ_p/ϵ_d, where ϵ_p and ϵ_d are the dielectric constants of the plasma and the rod, respectively. The phase velocity is found to be always greater than the velocity of a plane wave in the rod medium if ϵ_p is positive, while for its negative values the phase velocity can be either greater or less. From the point of view of power concentration, the structure acts as a very good surface waveguide, particularly for high negative values of ϵ_p/ϵ_d. The attenuation coefficient is subsequently derived by the standard perturbation method, assuming that both the plasma and the rod are slightly lossy. Finally, the possibility of using the waveguide as a plasma diagnostic tool is discussed, and it is shown how the results reported in the paper can be employed for determining the electron density and electron collision frequency for momentum transfer in a plasma. (auth)

6243 MICROSCOPIC INTERFEROMETRY OF LASER-PRODUCED PLASMAS. Attwood, D.T.; Coleman, L.W. (Lawrence Livermore Laboratory, Livermore, California 94550). Appl. Phys. Lett. 24: No. 9, 408-410 (1 May 1974).

Holographic microinterferometry is applied to the study of laser-produced plasmas. A 150-psec 1.06-μm light pulse from a neodymium laser is used for both production and diagnostics of the plasma. An interferogram, obtained 0.5 nsec after irradiation by a 1/2-J pulse, is presented. It is pointed out that spatial resolution is limited by plasma motion during passage of the 100-psec frequency-doubled diagnostic pulse. (auth)

Kinetics (General)

Refer also to abstracts 8524, 8744, and 8799.

6244 (GSI-73-9) UNILAC PROGRESS REPORT No. 9. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). Aug 1973. 37p. (In German).

This progress report comprises seven single reports: (1) Determination of best possible yields for multiply charged ions extracted from a duoplasmatron ion source. (2) The Faraday rooms of the UNILAC injector system. (3) The data acquisition system for the measurement of the field distribution in rf-cavities. (4) The pulse-control-system of the UNILAC. (5) A Digital Data transmission system with high noise immunity. (6) Measurement of phase errors between a 27 MHz and 108 MHz reference signal. (7) The communication system at the UNILAC. (INIS)

6245 GAS BREAKDOWN AND ITS FUNDAMENTAL PROCESSES. Proceedings of the U. S.-Japan Seminar, Tokyo, Japan, October 3-6, 1972. Takeda, S. (ed.). Tokyo; Japan Society for the Promotion of Science (1973). 260p. $18.50.

The behavior of low-energy electrons in gases is discussed together with the attachment of low-energy electrons to oxygen molecules, processes leading to the recombination of charged particles in ionized gases, ion-molecule reactions, and measurements of the Townsend ionization coefficients of argon-organic vapor mixtures. Other subjects considered include the role of medium-energy metastable particles in gas breakdown in nitrogen, the electrical breakdown initiated by an electron avalanche, and the streamer mechanism of discharge. The discharge development in compressed gases is investigated along with the breakdown of air gaps irradiated by a giant pulse laser. (IAA)

6246 PLASMA PHYSICS: THE LATEST INFANT OF THE CLASSICS. Gould, R. W. (Atomic Energy Commission, Washington, DC). pp 216-242 of Physics 50 Years Later. Brown, S. C. (Ed.). Washington, DC; National Academy of Sciences (1973).

The history of plasma physics is briefly reviewed. The discussion then centers on controlled fusion for power generation. The basic fusion reactions, confinement schemes, and some results from present tokamaks are discussed. (MOW)

6247 THERMAL CONDUCTIVITY, ELECTRICAL CONDUCTIVITY, VISCOSITY AND DIFFUSIVITY OF IONIZED SUSPENSION IN AN ELECTRIC FIELD. Wu, C. (Naval Academy, Annapolis, MD). pp 72-77 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

An ionized gas-solid suspension in an electric field was considered as a mixture at steady state and close to equilibrium condition. The rate processes which tend to move toward an equilibrium state are discussed. Some of the fundamental problems associated with transport properties are the interaction between particles which include determining cross sections and interaction potentials. The transport phenomena in an ionized suspension are characterized by the flux of mass (diffusivity), the flux of momentum (viscosity), the flux of thermal energy (thermal conductivity) and the flux of electric energy (electric conductivity). The transport coefficients are defined in terms of the flux vectors. Expressions for the transport coefficients are obtained in terms of integrals involving the interparticle potential functions. The absolute cgs system of units is used in all computations. In some cases, the practical system of electrical units such as ampere, volt, and joule is also used. (auth)

6248 VOPROSY TEORII PLAZMY. Vypusk 8. (Questions on the Theory of Plasma. Number 8). Leontovich, M. A. (ed.). Moscow; Atomizdat (1974). 384p.

Four chapters are presented in which different aspects of the magnetohydrodynamic flow of plasma are examined. The theory of symmetrical stationary flow of an idealized plasma is first considered. Two-dimensional flow in channels and a two-dimensional magnetohydrodynamic model of a z-pinch plasma focus are then analyzed. Plasma optics are discussed and general results are obtained by analytical methods using idealized models. (tr-auth)

6249 INVESTIGATION OF THE SPECTRAL CHARACTERISTICS OF THERMALLY IONIZED GASES (PLASMA). Kon'kov, A. A.; Vorontsov, A. V.; Kulagin, S. G.; Ryazin, A. P. (Inst. of High Temperatures, Moscow). High Temp.-High Pressures; 5: No. 4, 405-412 (1973).

Experimental study is reported of the spectral composition of radiation, of the emissivity, and of the absorption coefficients of krypton, xenon, argon, hydrogen, oxygen, nitrogen, air, and a 91% CO_2 + 9% N_2 mixture, heated in a shock tube. The temperature range covered was 5000 to 30,000 K, and the pressure range 3 to 150 atm. The experimental results are compared with calculated data. (auth)

6250 INTERNATIONAL COLLABORATION IN RESEARCH ON CONTROLLED THERMONUCLEAR FUSION. Pease, A. S.; Willson, D. R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Contemp. Phys.; 15: No. 2, 179-192 (Mar 1974).

After developing in secrecy, research on controlled thermonuclear reactions was declassified and became a subject of world-wide activity. During the last fifteen years of research, strong international collaboration has developed between the national laboratories conducting the research. So far, no central international laboratory has been constructed. As the program developed, it became clear that while the largest nations, U.S.A. and U.S.S.R. can both conduct the research on a broad basis and can contemplate the expense and risk of the technological development phase within their national resources, smaller nations have to work on a co-operative basis if they are to achieve the same ends without disproportionate national investment. The member states of Euratom initiated a collaborative arrangement in 1959 which, although complicated, has been comparatively successful. The arrangement can be characterized as a system of national programs roughly coordinated by a central subsidizing agency (Euratom). It is now evolving to meet the changing needs of the program and the addition of the British and Danish programs to it. Fusion research in the Euratom countries is likely to continue to have a collaborative international character which, in spite of difficulties, should enable joint European projects to be built up within Western Europe. An international design team for a large joint experiment has been established at Culham (U.K.). If all goes well technically, it will become necessary to provide a mechanism for involving industry at an international level and for giving a stronger central direction to the work. (auth)

6251 RADIATIVE LOSSES FROM AN ARGON PLASMA AND A RADIATION MODEL OF A CONTINUOUS OPTICAL DISCHARGE.

Kozlov, G. I.; Kuznetsov, V. A.; Masyukov, V. A. Zh. Eksp. Teor. Fiz.; 66: No. 3, 954-964(Mar 1974). (In Russian).

The properties of a continuous optical discharge are described quantitatively by analyzing the radiative balance at high pressures between absorption of laser radiation and the discharge radiation integrated over the spectrum. The formula for radiative losses by a dense plasma thus derived is confirmed by experimental measurements of a continuous optical discharge in argon. (auth)

6252 AZIMUTHALLY ASYMMETRIC MODES AND ANOMALOUS CONDUCTIVITY IN CLOSED ELECTRON DRIFT ACCELERATORS. Morozov, A.I.; Esipchuk, Y.V.; Kapulkin, A.M.; Nevrovskii, V.A.; Smirnov, V.A. (I. V. Kurchatov Atomic Energy Institute, Moscow). Sov. Phys.-Tech. Phys. 18: No. 5, 615-620 (Nov 1973).

An investigation is made of the anomalous plasma conductivity in closed electron drift accelerators. (AIP)

Kinetics (Experimental)

6253 (EUR-CEA-FC-707) EXPERIMENTAL STUDY OF THE STARK BROADENING OF THE LAMBDA = 4471.48 AND 4470.04A HeI SPECTRAL LINES EMITTED BY A PLASMA. Ramette, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1973. 169p. (In French). Dep. NTIS (US Sales Only) $11.50.

Thesis. Submitted to Paris Univ., Orsay.

A detailed study was made of the profile of the HeI lambda = 4471.48 A line and its forbidden component at lambda = 4470.04 A, emitted for an afterglow plasma having electron densities ranging from 1.5×10^{15} cm^{-3} to 2.2×10^{14} cm^{-3} and electron temperatures lying between 6300°K and 3400°K. A detailed description is given of the experimental device and the spectroscopic assembly for measuring the plasma parameters and the line profiles. The electron density was measured using laser interferometry. The electron temperature was determined spectroscopically from the Boltzmann plot of the population densities of highly excited He levels (principal quantum number n < 11). A ten channel analyzer served for measuring the line profiles. It was found that the wavelength shifts of the individual components and, thus, the peak separation are slightly smaller than predicted by theory, whereas the intensity in the valley between the two components is found to be slightly larger than the theoretical value. The measurements show that the position of the intensity minimum between allowed and forbidden components is shifted toward the allowed line when the temperature decreases. At low electron densities ($N_e < 5 \times 10^{14}$ cm^{-3}) the intensity in the forbidden line is proportional to the square of the normal field strength f_0. For $N_e < 5 \times 10^{14}$ cm^{-3}, the intensity increases and is proportional to f_0. (FR)

6254 (FRNC-TH-449) STUDY OF THE COLLISION BROADENING OF HeI LINES EMITTED BY A DENSE He PLASMA JET. Diatta, C. S. (Paris-11 Univ., 91-Orsay (France)). [nd]. 119p. (In French). Dep. NTIS (US Sales Only) $9.00.

Thesis.

Comparisons are made between theoretical and experimental profiles obtained for some isolated and nonisolated HeI lines observed in helium plasma jets having well defined characteristics (electron density, temperature). The agreement between experiment and the GRIEM theory (in which the ions are considered to be stationary particles) is very satisfactory (except for the 5875A line) when the experimental errors are taken into consideration (10%). The very large discrepancies (30 to 50%) obtained by KUSCH were not observed in successive measurements of the electron density N(e) of a helium-hydrogen plasma from broadening of the H(β) line and HeI lines. The differences observed between the experimental and theoretical 4471.5A and 4921.93A hydrogen like lines indicate, however, that in certain cases it is absolutely necessary to take the motion of the ions into consideration. (FR)

6255 (UPee-73-03) DECAY OF THE LONGITUDINAL PLASMA CURRENT RESULTING FROM THE INTERACTION WITH THE EXTERNAL CIRCUITS AND THE RESISTANCE OF THE LAYER NEAR THE WALL. Van der Laan, P. C. T. (Padua Univ. (Italy). Istituto di Elettrotecnica e di Elettronica). Mar 1973. 7p. INIS.

In toroidal screw pinch experiments the longitudinal plasma current is observed to decay rapidly. Several causes can contribute to this decay; here the author discusses the effect of losses in the external circuits, considering the resistivity of low-density plasma stagnating against the wall; currents in this stagnating layer cause an interaction between the two field components and an additional dissipation. (INIS)

6256 TIME DEPENDENCE OF ELECTRON SCATTERING IN A BEAM-PLASMA SYSTEM. Walsh, J.E.; Freese, K.B.; Levine, J.S. (Department of Physics and Astronomy, Dartmouth College, Hanover, New Hampshire 03755). Phys. Rev. Lett. 32: No. 7, 346-348 (18 Feb 1974).

The time dependence of fast-electron production in a beam-plasma system is observed experimentally. We find that the fastest particles are produced in pulses which are correlated with the quenching of one mode and the onset of a second lower-frequency faster phase velocity oscillation. (auth)

6257 CURRENT DISTRIBUTION NEAR THE NULL LINE OF A MAGNETIC FIELD AND TURBULENT PLASMA RESISTANCE. Syrovatskii, S.I.; Frank, A.G.; Khodzhaev, A.Z. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.-Tech. Phys. 18: No. 5, 580-586 (Nov. 1973).

An experimental study is made of the conditions under which current flows along the null line of a quadrupole magnetic field in a plasma with density $n \lesssim 10^{13}$ cm^{-3}. The current is shown to form a sheath whose longitudinal and transverse dimensions differ by a factor of 2-2.5. This sheath is not a neutral current sheath, however; it modifies the original magnetic field slightly because of the turbulent nature of the plasma conductivity, which results from the development of an ion-acoustic instability in the sheath. The attainment of a neutral current sheath would require an increase in the conductivity; this might be achieved by increasing the plasma density. (auth)

6258 MEASUREMENT OF THE THERMAL CONDUCTIVITY OF A HYDROGEN PLASMA IN A STABILIZED ELECTRIC ARC. Nizovskii, V.L.; Shabashov, V.I. (Institute of High Temperatures, Academy of Sciences of the USSR.). High Temp. 11: No. 2, 217-221 (Nov 1973).

An explanation is proposed for the discrepancies between the theoretical and experimental data on the thermal conductivity of a hydrogen plasma. It is shown that in the temperature range between the dissociation and the ionization peak of the thermal conductivity the discrepancy is due to the breakdown of chemical equilibrium in the region of the arc near the wall. At temperatures beyond the ionization peak, the concentration of neutral atoms varies by a factor of several units when there is even a small departure of the degree of ionization from the equilibrium value. This can lead to a large error in the measurement of the temperature and therefore the thermal conductivity. (auth)

6259 ION-BEAM PRODUCTION USING THERMIONIC ION EMISSION FROM SODIUM SILICATE IN A PLASMA. Sato, N.; Hatta, Y.; Hatakeyama, R.; Sugai, H. (Department of Electronic Engineering, Tohoku University, Sendai, Japan). Appl. Phys. Lett. 24: No. 7, 300-302 (1 Apr 1974).

By using thermionic ion emission from a water glass (sodium silicate, $Na_2O \cdot 2SiO_2$) an ion beam is easily produced in a plasma. Possible applications of the ion emission to plasma diagnostics are also described. (auth)

6260 TURBULENCE SPECTRUM OBSERVED IN A COLLISSION-FREE θ PINCH PLASMA BY CO_2 LASER SCATTERING. Bretz, N.L.; DeSilva, A.W. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 32: No. 4, 138-141 (28 Jan 1974).

Turbulence generated by a rapidly imploding current sheath in a high-voltage θ pinch has been investigated by CO_2 laser scattering and by emission spectroscopy of forbidden-line satellites in helium. Waves indicative of a saturated ion-sound instability are seen in the current sheath. In a region well behind the sheath, waves are seen with wave numbers near k_D. These waves may be the result of mode coupling from short-wave-number turbulence generated earlier by the passage of the current sheath. (auth)

Kinetics (Theoretical)

6261 (UCID-16494) COMMENTS ON OBTAINING A BOUNCE AVERAGE FOKKER-PLANCK EQUATION. Baldwin, D. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Apr 1974. Contract W-7405-eng-48. 7p. Dep. NTIS $4.00.

A procedure is suggested for obtaining directly a Fokker-Planck equation in the space of constants of the bounce motion which thereby avoids the relatively laborious task of bounce averaging the velocity space Fokker-Planck equation. (auth)

6262 NUMERICAL INTEGRATION OF THE VLASOV EQUATION. Shoucri, M.; Knorr, G. (Ames Lab., IA). Contract AT(11-1)-2059. J. Comput. Phys.; 14: No. 1, 84-92(Jan 1974).

A numerical method is described for the solution of the nonlinear Vlasov equation. The distribution function is expanded in a series of orthogonal polynomials, namely the Chebyshev polynomials. The conditions under which this expansion is valid are discussed. Recurrence effects are eliminated by formally adding a damping term to the eigenvalues of the truncated system. Nonlinear effects have been simulated by an amount of information corresponding to less than 500 "particles." (auth)

6263 PLASMA SIMULATION AS EIGENVALUE PROBLEM. Knorr, G.; Shoucri, M. (Ames Lab., IA). Contract AT(11-1)-2059. J. Comput. Phys.; 14: No.1,1-7(Jan 1974).

A numerical integration of the Vlasov equation replaces the continuous eigenvalue spectrum of the problem by a discrete spectrum, which can be represented by the eigenvalue spectrum of a finite matrix. The matrix must be dissipative, i.e., the eigenvalues must have a negative real part in order to avoid recurrence effects. Several dissipative terms in the diagonal of the matrix are studied numerically and analytically and the influence of various parameters is investigated. It is shown that a decrease of the last few off-diagonal terms in the matrix may also enhance the damping. (auth)

6264 TRANSPORT PHENOMENA IN A PARTIALLY IONIZED LORENTZIAN MAGNETOPLASMA. Jayaram, S.; Lakhina, G.S. (Department of Physics, Indian Institute of Technology, New Delhi, India); Buti, B. Ann. Phys. (N.Y.) 80: No. 1, 42-59 (Sept 1973).

Some transport coefficients are evaluated for a homogeneous, partially ionized Lorentizian plasma in the presence of a uniform external magnetic field. The electron–ion collisions are taken into account by means of the modified Fokker–Planck equation and the electron–neutral collision frequency, ν_{en} is taken as velocity (ω) dependent or velocity independent, depending on the energy range under consideration. The variation of the transport coefficients with magnetic field is determined for $\nu_{en} \propto \omega^s$ (s being a positive or negative integer) and one finds that qualitatively this behavior does not change by changing either the collision frequency or the velocity dependence of the collision frequency; however for weak magnetic fields the magnitudes of these transport coefficients increase with the decrease in ν_{en} or s, whereas for strong magnetic fields the transverse components of the transport coefficients decrease and the Hall components tend to saturate with the decrease of either the collision frequency or s. (auth)

6265 HEAT FLUX AND FORCE OF FRICTION ACROSS A MAGNETIC FIELD IN A STRONGLY IONIZED TURBULENT PLASMA. Baimbetov, F. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 1-6(1973). (In Russian).

The effect of plasma oscillations on the heat flux and the force of friction in a magnetoactive strongly ionized plasma was investigated by the Chepmen–Kauling method. It was shown that the plasma oscillations of sufficiently high intensity can have a significant effect on the transfer process. (tr-auth)

6266 FORMATION OF A PLASMA SHEATH NEAR A PLANE ABSORBING CONDUCTOR. Anderson, N. (York Univ., Eng.). Int. J. Electron.; 36: No. 4, 551-557(Apr 1974).

A model describing the formation of a plasma sheath in the neighborhood of a plane absorbing conducting wall is considered. Expressions are derived for the electric potential in the plasma and for the ion and electron densities. The validity of the model is restricted to cases in which the wall potential is monotonic in time. (auth)

6267 TIME FOR THE TEMPERATURE COMPENSATION OF PARTICLES OF ULTRARELATIVISTIC PLASMA. Baimbetov, F. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 73-75(1973). (In Russian).

From the integral for the collisions of relativistic particles with transition to the ultrarelativistic range ($\vec{v} = c(\vec{\beta}/\rho)$), the integral was obtained for ultrarelativistic particles. The question of the time for temperature compensation of the electrons and ions of the ultrarelativistic plasma was investigated using this integral. It was shown that during a time of the order of $T = 9/20 \times (\chi T)^2/\pi c^2 l_i^2 \lambda c n_i$ temperature compensation of the ultrarelativistic electrons and ions occurs. (tr-auth)

6268 DISTRIBUTION OF CHARGED AND NEUTRAL PARTICLE CONCENTRATIONS IN A QUASISTATIONARY HIGH TEMPERATURE TURBULENT PLASMA. Kitainer, A. G.; Sholin, G. V. Sov. J. At. Energy (Engl. Transl.); 33: No. 5, 1064-1065 (Nov 1972).

Translated from At. Energ. (USSR); 33: No. 5, 917(Nov 1972).

The problem is solved for the case of a high-temperature, turbulent, confined plasma. Quasistationary conditions are considered, in which the mean free path of the atoms, as compared with the ionization, charge transfer, and elastic scattering length exceeds the dimensions of the system. The diffusion coefficient and the ionization rate for atoms due to electron collisions are assumed to be constants. (MOW)

6269 RELAXATION THEORY OF PLASMA-BROADENED He II LINES. O'Brien, J. T. (Phillips Petroleum Co., Bartlesville, OK); Hooper, C. F. Jr. J. Quant. Spectrosc. Radiative Transfer; 14: No. 6, 479-496(Jun 1974).

The relaxation theory of plasma line broadening developed by Smith and Hooper, and extended by Smith, is applied to a charged radiator. The 304 Å Lyman alpha line of He II is chosen as an example. The radiator is assumed perturbed only by electronic and ionic electric microfields. The ions are treated in the static approximation. Two-component ion microfield distribution functions that allow for the presence of both He^+ and He^{++} perturbers are employed. The fact that the radiator is charged complicates the treatment of electron perturbations; two different approaches are included. The first neglects the effect of the charge of the radiator on the perturbing electron and assumes that the perturbing electrons can be represented by momentum wave functions. This method corresponds to Smith's treatment of the electron perturbers in neutral hydrogen. The second includes the effect of the charge of the radiator on the perturbing electrons and represents the perturbing electrons by Coulomb wave functions; this calculation requires evaluation of free-free gaunt factors. The theory, with both the momentum and Coulomb perturber wave functions, predicts a blue asymmetry in the near wings of the line. These two approaches can be compared with the classical path approach of Griem and Shen. (auth)

6270 PARTITION FUNCTION FOR A TWO-DIMENSIONAL PLASMA IN THE RANDOM-PHASE APPROXIMATION. Seyler, C.E. Jr. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). Phys. Rev. Lett. 32: No. 10, 515-517 (11 Mar 1974).

The partition function for a two-dimensional plasma is evaluated within the random-phase approximation. The periodic boundary conditions are taken fully into account by including the periodic image interactions. In the guiding-center limit, the "negative temperature" threshold energy is evaluated, and a value different from previous calculations results. When an identical random-phase evaluation is applied to the finite-gyroradius plasma, the Salzberg–Prager–May equation of state is recovered. (auth)

6271 ELECTRICAL CONDUCTIVITY OF A NON-DEBYE PLASMA. Kaklyugin, A.S.; Norman, G.E. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 11: No. 2, 205-210 (Nov 1973).

A study is made of the electrical conductivity of a plasma under conditions when the number of particles in the Debye sphere is reduced to unity. The Lorentz-model with a screened potential is used. Allowance is made for the spatial correlation of colliding particles; this leads to the localiztion of some of the free electrons in a nonideal plasma and thus reduces the plasma conductivity. A screening radius that slightly exceeds the Debye radius is introduced. The electron energy distribution function is calculated. A simple expression is found for the ratio of the conductivities calculated with and without allowance for the nonideal behavior of the plasma. The results agree well with the available experimental data. (auth)

6272 CONDENSATION OF PHOTONS IN A HOT PLASMA. Chapline, G.; Cooper, G.; Slutz, S. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. A 9: No. 3, 1273-1277 (Mar 1974).

The Compton cooling of a photon gas is studied using the Compton–Fokker–Planck equation. Numerical solutions of the Fokker–Planck equation are presented which illustrate the possibility of forming a temporary excess of low-energy photons. The conditions under which it would be possible to observe this excess of low-energy photons are derived. The possibility of using stimulated Compton scattering to generate coherent x rays is also discussed. (auth)

Production

Refer also to abstracts 6243, 6449, and 6819.

6273 (AD-769459) FIELD-GENERATING THERMAL INSTABILITY IN LASER-HEATED PLASMAS. Tidman, D. A.; Shanny, R. A. (Science Applications, Inc., La Jolla, Calif. (USA)). Oct 1973. Contract N00014-72-C-0114. 21p. (NRL-MR-2667). NTIS $3.25.

The intense thermal energy flux emanating from the critical layer in laser-produced plasmas is shown to generate an instability that derives from the magnetic field dependence of the thermal conductivity. This implies that B fields, with their attendant nonuniform heating effects, will occur even in uniformly irradiated spherical pellets or plane slabs. These fields may play a role in attempts to compress pellets for fusion for example by being partially trapped and amplified by compression in the interior of a pellet. (auth)

6274 (LA-5532-MS) PLASMA CHEMISTRY AND THE DYNAMICS OF CARBON FOILS IRRADIATED BY HIGH INTENSITY LASER PULSES. Rockwood, S. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

Calculations are presented which display the temporal behavior of electron and ion temperatures and ion number densities during the evolution of a carbon plasma irradiated by an intense laser pulse. These plasma kinetics calculations are coupled with a one dimensional Lagrangian hydrocode simulation of the disassembly of thin carbon foil targets. Results of these calculations show line radiation from the targets to be negligible for incident fluxes $\phi > 10^{14}$ watts/cm^2 while bound free radiation represents the dominant radiation loss in many cases of interest. From the results of the numerical calculations an analytic model is developed which predicts the experimentally observed dependence of transmission through thin targets as a function of laser and target parameters. (auth)

6275 (SLA-74-122) ELECTRON-BEAM-INDUCED FUSION. Beckner, E. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 7p. Dep. NTIS $4.00.

There is increasing interest in the use of tightly focused relativistic electron beams, as an alternative to lasers, for heating and compressing matter to achieve fusion. Introductory information on the promising aspects of the electron-beam technique, the problems involved, and the areas to be investigated with a view to improving the technology is presented. (auth)

6276 FUSION BY LASERS. Witkowski, S. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1972). vp. (In German).

From information meeting of the Max-Planck-Institut fuer Plasmaphysik; Garching, Germany (7 Nov 1972).

A state-of-the-art survey of activities throughout the world in plasma generation to be achieved by lasers is given. The main problems and research areas are enhancement of laser efficiency and absorption rate of the plasma, density and compressional studies of the originally frozen hydrogen spheres. (GE)

6277 KINETIC STUDIES OF FISSION FRAGMENT, ^{3}He(n,p)t, AND GAMMA RAY PRODUCED PLASMAS. Ellis, W. H.; Imani, K. (Univ. of Florida, Gainesville). pp 45-52 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The pulsed ionization chamber diagnostic technique was applied to the study of plasmas produced by nuclear methods. Loss coefficients were measured for pressure (temperatures) of 1 to 27 atm (300-823°K), ionization rates of 10^7 to 10^{14} cm^{-3} sec^{-1}, and densities of 10^5 to 10^{11} cm^{-3}. Second order loss coefficients obtained at 300°K were α_2 (1 to 10 atm ^{3}He) = 5.3 to 30 × 10^{-7}, α_2 (1 & 10 atm ^{4}He) = 7.0 & 16 × 10^{-7}, α_2 (1 & 10 atm ^{3}He-CO_2) = 1.8 × 10^5, and α_2 (1 atm Ar-N_2) = 9.2 × 10^{-6} (cm^3/sec). Fission produced plasmas yielded α_2's 3 to 4 times larger than gamma rays. The enhancement, shown to be due to columnar recombination, agreed with that calculated from theory to within 3 to 4%. He α_2's exhibited a $N^{0.4}$ atom density dependence and maxima at approximately 450°K, thereafter assuming a $T^{-\frac{1}{2}}$ dependence. The N_2 and CO_2 mixtures exhibited $T^{-\frac{1}{2}}$ dependence throughout. (auth)

6278 SPHERICAL HYDROGEN TARGETS FOR LASER-PRODUCED FUSION. Lewkowicz, I. (Israel Atomic Energy Commission, Yavne). J. Phys., D (London); 7: No. 4, L61-L62 (1 Mar 1974).

A new method is described for the preparation of spherical high-pressure hydrogen targets to be used in laser-produced fusion experiments. (auth)

6279 PLASMA PRODUCTION FROM SOLID TARGETS BY NANOSECOND PREPULSES. Goldman, E.B.; Leising, W.; Brauer, A.; Lubin, M.J. (Laboratory for Laser Energetics, College of Engineering and Applied Science, University of Rochester, Rochester, New York 14627). J. Appl. Phys. 45: No. 3, 1158-1170 (Mar 1974).

A model of the laser-plasma-solid system is developed to study the dynamics of the laser prepulse interaction with initially solid slabs. Experiments are conducted using aluminum wires and fast-rise ruby lasers and the results are used to verify the theoretical model. The results of numerical experiments are used to investigate the dependence of plasma formation on the prepulse parameters and to find those parameters which lead to efficient coupling of a subsequent giant heating pulse with the target material. (auth)

6280 MEASUREMENTS OF ELECTRON DENSITY EVOLUTION AND BEAM SELF-FOCUSING IN A LASER-PRODUCED PLASMA. Johnson, L.C.; Chu, T.K. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 32: No. 10, 517-520 (11 Mar 1974).

Space- and time-resolved interferometric measurements of electron density in a CO_2-laser-produced plasma in helium show the development and evolution of radial profiles with on-axis minima, resulting in self-focusing of the laser beam. (auth)

6281 CO_2-LASER-DRIVEN DETONATION WAVES IN THE PRESENCE OF A STRONG MAGNETIC FIELD. Halverson, W. (Francis Bitter National Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Appl. Phys. Lett. 24: No. 8, 364-366 (15 Apr 1974).

CO_2-laser-driven detonation fronts have been studied in low-pressure hydrogen and helium with axial magnetic fields up to 88 kG. At pressures above 100 Torr the shock front propagates toward the laser and the magnetic field has no observable effect. At lower pressures and no field, plasma fronts move both toward and away from the laser. The 88-kG field confines the plasma radially and causes the "downstream" front to disappear. The shock motion is well described by the modified detonation model of Daiber and Thompson. (auth)

6282 X-RAY EMISSION FROM A CO_2-LASER-PRODUCED PLASMA. Dyer, P.E.; James, D.J.; Ramsden, S.A.; Skipper, M.A. (Department of Applied Physics, University of Hull, Hull, HU6 7RX, England). Appl. Phys. Lett. 24: No. 7, 316-317 (1 Apr 1974).

A 0.3-GW, 60-ns TEA CO_2 laser has been used to create plasma from a solid carbon target. Studies of the x-ray emission from the plasma at 4×10^{11} W/cm^2 indicate the existence of a high-energy electron component with an equivalent temperature of ~2 keV. (auth)

6283 CONVERSION EFFICIENCIES OF LASER TO X-RAY ENERGY IN C, F, AND Al PLASMAS. Whitney, K.G. (Science Applications Incorporated, Arlington, Virginia 22209); Davis, J. Appl. Phys. Lett. 24: No. 10, 509-511 (15 May 1974).

A simple, but illustrative, nonhydrodynamic model is described which predicts potentially large conversion efficiencies of laser to x-ray energy in laser-heated plasmas. It is found that, when laser energy is deposited in 25 psec into the electron gas, a substantial conversion to x rays is possible in less than 1 nsec, provided the energy deposited per unit volume is not excessive. Moreover, while maximum K-line conversion increases with ion density, for a fixed electron critical density it decreases with increasing plasma Z. (auth)

6284 HARMONIC GENERATION AND FREQUENCY MIXING IN LASER-PRODUCED PLASMAS. Lee, P.; Giovanielli, D.V.; Godwin, R.P.; McCall, G.H. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Appl. Phys. Lett. 24: No. 9, 406-408 (1 May 1974).

Spectral measurements of light scattered at various angles from a laser-produced plasma were made at the laser frequency ω_L, and at $\omega_L/2$, $3\omega_L/2$, $2\omega_L$, $5\omega_L/2$, and $3\omega_L$ using a mode-locked Nd:glass laser to produce intensities of 10^{16} W/cm^2 at the target. Signals were detected at ω_L, $3\omega_L/2$, and $2\omega_L$, and their intensities relative to the incident intensity were determined. Upper bounds were set for the intensities at the other frequencies. (auth)

6285 SELF-GENERATED MAGNETIC FIELDS ASSOCIATED WITH A LASER-PRODUCED PLASMA. McKee, L.L.; Bird, R.S.; Schwirzke, F. (Naval Postgraduate School, Monterey, California 93940). Phys. Rev. A 9: No. 3, 1305-1311 (Mar 1974).

The dependence of the self-generated magnetic fields associated with a laser-produced plasma on position, time, incident laser power, and nitrogen background pressure has been investigated. The presence of the ambient background is found to influence the generation of the fields during the laser irradiation of the plasma. This influence continues long after laser shutoff and causes the fields to reverse their direction. (auth)

6286 INVESTIGATION OF THE ENERGY AND IMPURITY CONTENT OF A CROSSED-FIELD PLASMA GUN. Baker, C.C.; Forsen, H.K. (Department of Nuclear Engineering, The University of Wisconsin, Madison, Wisconsin 53706). J. Appl. Phys. 45: No. 5, 2099-2106 (May 1974).

The downstream energy and impurity content of the plasma produced by a pulsed crossed-field source is investigated. With a positive center electrode and an optimum neutral gas loading, the source ionizes and accelerates 7×10^{17} protons containing 140 J of energy to the end of a 2-m-long axial magnetic guide field. This energy is distributed equally between axial motion and gyromotion. The dominant acceleration method is the $-\mu\cdot\nabla B$ force resulting from a gradient in the axial magnetic field within the source. Impurities, in the form of C^{2+} and O^{2+} ions, account for about 10% of the plasma. Reversing the source polarity results in a lower energy efficiency and the appearance of Fe^{2+} ions in the downstream plasma. (auth)

6287 NUMERICAL STUDIES OF EXPLODING-WIRE PLASMAS. Chapin, D.L.; Duderstadt, J.J.; Bach, D.R. (Department of Nuclear Engineering, The University of Michigan Ann Arbor, Michigan 48105). J. Appl. Phys. 45: No. 4, 1726-1729 (Apr 1974).

A plasma created by exploding a thin lithium wire in a vacuum is analyzed using a magnetohydrodynamic (MHD) model. The two-temperature MHD equations including finite thermal conductivity and electrical resistivity are derived in one-dimensional cylindrical

geometry. The resulting system of six coupled nonlinear partial differential equations in six unknowns is then solved numerically. Results of the calculation including spatial dependence of density, temperature, and magnetic field and time dependence of the radial profile and average temperature are given. These calculated properties are compared to available experimental results, giving favorable agreement. (auth)

Stability

Refer also to abstracts 6273 and 7707.

6288 (FRNC-TH-434) STUDY OF DRIFT WAVES AND THEIR STABILIZATION WITH A HIGH FREQUENCY FIELD. Pelletier, G. (Grenoble-1 Univ., 38 (France)). 1972. 105p. (In French). Dep. NTIS (US Sales Only) $8.25.

Thesis.

A deep understanding of low-frequency instabilities in a plasma column and the conditions under which they occur became necessary for the development of the Phaeton program for investigating the stabilization of drift waves using high-frequency fields. A theoretical study based on the Vlasov equation for the noncollisional regime and the Vlasov equation completed by the Krook term for the collisional regime was effected. This study established the competition between the two types of wave, i.e., diamagnetic drift waves and pseudo-sound waves. The physics of these waves is independent of the way in which the dissipation occurs. When the pseudo-sound wave is more important than the diamagnetic wave, the plasma is stable except when the longitudinal current exceeds the pseudo-sound velocity. In this case, the instability is not dangerous for the confinement, as it propagates along the axis. It can be envisaged as heating the ions. On the other hand, when diamagnetism dominates, the plasma becomes unstable. The instability is propagated azimuthally and generates an abnormal diffusion, the existence of a longitudinal current only aggravating the situation. The term introduced by the high frequency plays the same role in limiting drift instabilities as that introduced by the motion of the ions parallel to the magnetic field. It is noted that forced oscillations may have as much effect as the electromagnetic pressure gradient. The experience demonstrates that the high frequency field stabilizes. Nothing, however, enables the theoretical model to be confirmed, studies of the penetration of the electric field in the plasma posing both theoretical and experimental difficulties. (FR)

6289 (UPee-72-07) ANALYSIS OF HIGH BETA PLASMAS. Grossmann, W. (Padua Univ. (Italy). Istituto di Elettrotecnica e di Elettronica). Dec 1972. 131p. INIS.

Six lectures on the analysis of high-beta plasmas, held in Padua University, were considered. The information contained herein represents the point of view of the author concerning the use of MHD in describing high-beta plasma stability. Methods are given for determining whether or not standard types of plasma profiles are stable. For unstable plasmas, methods are given for the calculation of the growth rates of particular unstable modes. (INIS)

6290 KELVIN-HELMHOLTZ DISCONTINUITY IN TWO SUPERPOSED PLASMAS. Bhatia, P. K. (Univ. of Jodhpur, India); Steiner, J. M. Aust. J. Phys.; 27: No. 1, 53-57(Feb 1974).

An investigation was made of the effects of collisions with neutral particles on the stability of the plane interface separating two streaming superposed plasmas of uniform densities. It has been found that, whereas the ambient magnetic field has a stabilizing influence, a collision frequency has a stabilizing effect when it is small and a destabilizing effect when it exceeds a certain value. (auth)

6291 VARIABLE GAIN-PHASE METHOD FOR FEEDBACK STABILIZATION OF MULTIMODE PLASMA INSTABILITIES. Sen, A. K. (Columbia Univ., New York). Plasma Phys.; 16: No. 6, 509-515(Jun 1974).

A method of feedback stabilization of multimode plasma instabilities using only one pair of sensor and controller was developed. The gain and phase requirements of the feedback structure were obtained from the usual single mode stabilization technique. A physically realizable feedback system was then derived with the gain-phase characteristics at modal frequencies. The method was applied to multimode weak reactive and dissipative electrostatic plasma instabilities. (auth)

6292 SATURATION OF THE ION-ACOUSTIC INSTABILITY IN A WEAKLY IONIZED PLASMA. Yamada, M.; Raether, M. (Department of Physics and Coordinated Science Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. Lett. 32: No. 3, 99-102, (21 Jan 1974).

The spatial saturation and the frequency dependence of the energy spectrum of ion-acoustic waves in a low-pressure discharge in helium in the pressure range 0.03-0.2 Torr has been investigated. In the high-pressure region the spectrum is peaked around the most unstable frequency predicted by linear theory [i.e., $\omega_{peak} \sim (1/\sqrt{3})\,\omega_i$], and the wave energy saturates at the modest value of $W/nT_e \simeq 10^{-3}$. At low pressures the wave energy increases and varies with frequency according to $W(\omega) \propto \omega^{-\alpha}$, with α assuming values between 2.2 and 2.8. (auth)

6293 EQUILIBRIUM AND ELECTROSTATIC STABILITY THEORY OF TOKAMAKS FROM THE DRIFT-KINETIC EQUATION. Cheung, L.; Horton, W. Jr. (Center for Plasma Physics and Thermonuclear Research, Department of Physics, The University of Texas at Austin, Austin, Texas 78712). Ann. Phys. (N.Y.) 81: No. 1, 201-230 (Nov 1973).

From the Vlasov equation a reduced kinetic equation, defined as the drift-kinetic equation, is derived by the small gyroradius expansion theory. The reduced equation is of the form $df/dt=0$ where f is the distribution of guiding centers, and the time derivative is taken along the particle orbits in the drift approximation. The derived kinetic equation is taken for the basis of the study of equilibria and electrostatic stability in axisymmetric, toroidal geometry. From the integral mode equation derived in the stability analysis, the theory of the current driven and the ballooning drift mode is developed and applied to tokamak plasmas. (auth)

6294 EFFECT OF DISSIPATIVE EFFECTS ON THE PROCESS OF NONLINEAR SATURATION OF EXPLOSION INSTABILITY. Aristov, V. V.; Kogan, E. Ya.; Oraevskii, V. N.; Pavlenko, V. P. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 12, 2075-2077(Dec 1973). (In Russian).

The role of dissipative effects in the process of nonlinear stabilization of explosive instabilities is discussed. The analysis is made on the basis of a solution of a system of differential equations with consideration of the attenuation and nonlinear displacement of the frequency of each wave. (tr-auth)

6295 EFFECT OF DISSIPATION DUE TO FIREHOSE INSTABILITY ON HALF-JET FLOW OF A COLLISIONLESS PLASMA. Morioka, S. (Osaka Univ.); Spreiter, J. R. (Stanford Univ., CA). pp 83-89 of Dynamics of Ionized Gases. Tokyo; Tokyo University Press (1973).

The discussion is limited to aligned and perturbation flow. It is shown that the dissipation terms are proportional to the fluctuation energy density in the main flow, and that they are nonlinearly related to other quantities through the growth rate parameter of instability. (IAA)

6296 BACKSCATTERING DECAY PROCESSES IN ELECTRON BEAM-PLASMA INTERACTIONS INCLUDING ION DYNAMICS. Quon, B.H.; Wong, A.Y.; Ripin, B.H. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 32: No. 8, 406-409 (25 Feb 1974).

Electron plasma waves driven unstable by the electron beam-plasma instability are observed to decay into convectively and absolutely growing ion waves and electron waves propagating in opposite directions. Ion waves excited to large amplitudes further couple with the high-frequency unstable waves to produce nonresonant short-wavelength electron modes. The nonresonant modes are found effective in accelerating electrons and thermalizing the beam. (auth)

6297 LINEAR STABILITY ANALYSIS OF LASER-DRIVEN SPHERICAL IMPLOSIONS. Shiau, J.N.; Goldman, E.B.; Weng, C.I. (Laboratory for Laser Energetics, College of Engineering and Applied Sciences, University of Rochester, Rochester, New York 14627). Phys. Rev. Lett. 32: No. 7, 352-355 (18 Feb 1974).

A linear approximation method has been developed to study the stability of spherically symmetric hydrodynamic motion. Application of this technique to laser-driven spherical implosions indicates that the implosions are linearly unstable to perturbations at the ablating surface. (auth)

6298 DECAY INSTABILITY OF THE ION-BEAM MODE. Stern, R.A.; Decker, J.F.; Platzman, P.M. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. Lett. 32: No. 7, 359-362 (18 Feb 1974).

Linearly stable slow-beam modes in ion-beam plasma systems are shown experimentally and theoretically to be unstable against parametric decay into subharmonic modes on the same (slow beam) branch. (auth)

6299 PARAMETRIC INSTABILITY IN A BOUNDED, HOMOGENEOUS PLASMA. Aliev, Y.M.; Gradov, O.M.; Kirii, A.Y. (M. V. Lomonosov Moscow State University). Sov. Phys.-Tech. Phys. 18: No. 6, 739-742 (Dec 1973).

The nonlinear absorption of a transverse electromagnetic wave in a bounded, homogeneous, transparent plasma is studied in this paper; the absorption is caused by energy transfer to parametrically excited longitudinal waves. A significant increase of the effective conductivity,

with a corresponding decrease of the penetration depth, are found as compared with linear penetration. (auth)

6300 INTERACTION OF A HOLLOW ELECTRON BEAM WITH A PLASMA. Ivanov, S.T. (P. N. Lebedev Institute of Physics, Academy of Sciences of the USSR, Moscow). Sov. Phys.-Tech. Phys. 18: No. 5, 607-611 (Nov 1973).

The interaction of a hollow electron beam of external radius b and internal radius a is considered in the two-fluid hydrodynamic approximation. A dispersion equation is obtained and is analyzed in the longwave ($ka \lesssim kb \ll 1$) and shortwave ($1 \ll ka \lesssim kb$) limits. Electrostatic instabilities are investigated and the frequencies and growth rates for electromagnetic waves excited by the beam are determined. (auth)

6301 A NEW TYPE OF IONIZATION INSTABILITY IN A PLASMA WITH NEGATIVE IONS. Alanakyan, Y.R. (All-Union Scientific-Research Institute of Engineering-Physics and Radioengineering Measurements.). High Temp. 11: No. 3, 587-588 (Jan 1974).

It is shown that the presence of negative ions can lead to a build-up of ionization oscillations in a weakly ionized plasma. (AIP)

6302 LOW-FREQUENCY INSTABILITIES IN MAGNETIZED PLASMA WITH NONUNIFORMLY COMPRESSED FLOW. Nambu, M.; Tamao, T. (Geophysical Research Institute and Geophysics Research Laboratory, University of Tokyo, Tokyo 113, Japan). Phys. Rev. Lett. 32: No. 11, 578-581 (18 Mar 1974).

The new wave-particle adiabatic interaction due to compressed flow is found by kinetic equations. Compressed flow means $\mathrm{div}\vec{V}_E \neq 0$, where $\vec{V}_E$ is the electric-field drift velocity. The adiabatic destabilization due to compressed flow is effective for the fast magnetosonic modes. These hydromagnetic drift instabilities would be important in the transition region where the Earthward motion of the tail plasma sheet is mostly retarded, as well as in laboratory adiabatic compression experiments. (auth)

6303 A STUDY OF INHOMOGENEITIES OF A PLASMA BETWEEN COAXIAL ELECTRODES IN A MAGNETIC FIELD. Golubev, V.S.; Lebedev, F.V. (Scientific-Research Institue of Nuclear Physics, Moscow State University). High Temp. 11: No. 2, 211-216 (Nov 1973).

Results of experimental studies of argon-cesium and helium-cesium current-carrying coaxial discharge plasmas in a transverse magnetic field are reported. The buildup of over-heated stratifications, containing wholly ionized seeu in the absence of magnetic fields, the influence of plasma dimensions on the topology and formation time of the ionization instability, and the influence of ionization turbulence on magnetic contraction are discussed. (auth)

6304 MAGNETOHYDRODYNAMIC INSTABILITY IN A DIRECT-CURRENT PLASMATRON. Stefanov, B.; Enikov, R. (Institute of Electronics, Bulgarian Academy of Sciences, Sofia). High Temp. 11: No. 2, 349-353 (Nov 1973).

Preliminary results of an experimental study of instabilities occurring in a plasma column of an arc discharge stabilized by a cold wall in a longitudinal magnetic field are presented. (auth)

6305 TEMPORAL ELECTROSTATIC INSTABILITIES IN INHOMOGENEOUS PLASMAS. Lee, Y.C.; Kaw, P.K. (University of California, Los Angeles, California 90024). Phys. Rev. Lett. 32: No. 4, 135-138 (28 Jan 1974).

The parametric process where the electromagnetic wave drives two Langmuir oscillations near $2\omega_p$ can be shown to be temporally unstable even in inhomogeneous plasmas. The instability arises because of wave trapping which prevents the convection of wave energy out of the unstable region. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 6286, 6376, 7420, and 7515.

6306 (CLM-R-122) CLEO-TOKAMAK EXPERIMENT. Gibson, A.; Bickerton, R. J.; Cole, H. C.; Haegi, M.; Hugill, J.; Paul, J. W. M.; Reynolds, P.; Sheffield, J.; Speth, E.; Stott, P. E. (UKAEA Research Group, Abingdon. Culham Lab.). Apr 1973. 8p. (CONF-730315-16). Dep. NTIS (US Sales Only) $4.00 UK 50 pence.

From 3rd international symposium on toroidal plasma confinement; Garching, F.R. Germany (26 Mar 1973).

Tokamak discharges have been established without using a thick conducting shell. Currents up to 70 kA and gross stability for up to 80 msec are obtained. No obvious instability or loss is produced when a 48-kW neutral beam is injected tangentially into the plasma. (auth)

6307 (CONF-730942-P6B-8, pp vp Paper L 5/1) SWELLING, CREEP, AND THERMAL FATIGUE ANALYSIS FOR CYLINDRICAL FUSION REACTOR VACUUM WALL. Ma, B. M. (Iowa State Univ. of Science and Tech., Ames). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F.R. Germany (10 Sep 1973).

The vacuum-chamber wall or vacuum wall of a controlled fusion reactor will eventually be operated under severe conditions of irradiation damage, swelling, creep and thermal fatigue. The desirable wall material is an alloy of the refractory metals. For high thermal efficiency of the fusion reactor, the operating temperature range of the vacuum wall is expected to be from 600 to 1000°C. Heat generation and temperature distribution in the wall are induced mainly from attenuation of neutrons and gamma rays. The most serious irradiation damage in the wall are dimensional and volumetric instabilities due to voids, bubbles and swelling of inert gases such as helium. The most important changes in mechanical properties of the wall material are: (a) ductility reduction, (b) enhanced irradiation creep, and (c) thermal fatigue due to cycling effect (especially for a pulsed fusion reactor). The objectives of this paper are to analyze the irradiation swelling, the creep stresses and strains and the lifetime of the vacuum wall resulting from severe irradiation, high temperature, and thermal fatigue. Surface blistering and irradiation swelling are produced by deuterium, tritium, helium, and temperature gradients in the wall. The creep rate of the wall is greatly enhanced by irradiation damage and swelling. From the consideration of intensive radiation, high heat generation rate, large temperature variation, and enhanced creep rate, and on the basis of some basic assumptions, the irradiation swelling, creep stresses and creep strain rates can be analyzed. Since the vacuum wall is subject to repeated thermal shocks and thermal loadings due to thermonuclear reactions of a controlled fusion reactor, thermal fatigue of the wall will occur. From some important factors of thermal cycling, the thermal fatigue can be analyzed and the lifetime of the vacuum wall may be predicted. (auth)

6308 (CONF-740509-5) SUPERCONDUCTING TOROIDAL MAGNETS FOR FUSION FEASIBILITY EXPERIMENTS AND POWER REACTORS. Lubell, M. S. (Oak Ridge National Lab., Tenn. (USA)). 1974. 43p. Dep. NTIS $5.25.

From fifth international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

It has been recognized that large superconducting magnets will have to be developed in order to obtain power economically from a thermonuclear reactor. Reasons are given in order to illustrate how vital they are even for the sizes envisioned for hydrogen feasibility and D-T burning experiments. Detailed discussion is given on the type of magnets used for the plasma confinement in a tokamak-type machine. Illustrations are given to show that their development is within the present technological progress of superconductivity. The methods used to estimate the cost of such a toroidal system are provided along with how the cost varies with changes in magnet aspect ratio, major radius, and stored energy. The latter quantity is presented as a valid figure of merit for quickly estimating the cost of any large superconducting toroidal system. (auth)

6309 (COO-3028-7) UTILIZATION OF PLASMA EXHAUST ENERGY FOR FUEL PRODUCTION. Fish, J. D.; Axtmann, R. C. (Princeton Univ., N. J. (USA). Dept. of Chemical Engineering). 1973. 24p. Dep. NTIS $4.25.

The plasma exhausts from fusion reactors represent a source of high-grade energy which might be utilized to produce chemical fuels via endothermic reactions. This article examines electrolytic, radiolytic and photolytic processes in terms of the energy required to produce a mole of hydrogen gas from the dissociation of water. The results indicate that while electrolysis is not clearly superior from the standpoint of energetics, practical consideration would probably preclude the use of the other schemes. (auth)

6310 (DP-MS-73-64) FUEL AND BLANKET MANAGEMENT AND SUPPLY IN COMMERCIAL FUSION. Hennelly, E. J. (DuPont de nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. 10p. (CONF-740402-35). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Lithium blanket inventory in D-T fusion power systems should be as low as practical to increase the ultimate amount of lithium available for large-scale conversion to tritium fuel. A substantial increase in the world-wide rate of mining and producing lithium must be initiated soon to support the projected rapid growth in fusion power expected to begin as early as 1990. Known resources of lithium seem adequate for the long term. However, if the ratio

of blanket lithium inventory to 30-year burnup never falls below 50, the long-term potential energy extractable from D–T fusion in a given number of reactors is restricted by the same factor. The need for tritium fuel to start up the first D–T fusion reactors in 1990–2000 requires an early commitment by 1985 and preplanning for producing the tritium supply from fission power reactors. Helium-3 cannot be supplied in practical amounts as initial fuel. (auth)

6311 (LA-UR-74-580) LASER FUSION POWER PLANT SYSTEMS ANALYSIS. Finch, F. T.; Kern, E. A.; Williams, J. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 17p. (CONF-740402-20). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

A power-plant simulation program was developed and utilized to make initial estimates of power costs and to assess the effects of variations of selected system parameters for several laser-fusion 1000-MWe reference concepts. Parameters affecting the plant duty cycle and primary energy balance and techniques for assessing the effect of component maintenance and replacement schedules, based on variable component mean-life criteria, were included. (auth)

6312 (LA-UR-74-583) DIELECTRIC BREAKDOWN OF POTENTIAL RTPR FIRST WALL INSULATOR MATERIALS. Bunch, J. M.; Clinard, F. W. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 11p. (CONF-740402-27). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Dielectric strength of Al_2O_3 and a number of other refractory insulators was evaluated using both dc and pulsed voltages, at temperatures up to 1073°K. Results were compared with those for alkali halides. The dielectric breakdown behavior of the low porosity insulators was qualitatively similar to that of alkali halides, indicating that the breakdown mechanisms are also similar. Pulsed voltage breakdown strength was found to be considerably greater than dc strength for low porosity materials, an observation of considerable engineering importance for the RTPR design. It appears that porosity has a deleterious effect on dielectric strength, both by reducing dc values and by suppressing the enhancement predicted to accompany pulsed voltage application at high temperature. (auth)

6313 (LA-UR-74-592) SOME NEUTRONICS ASPECTS OF LASER-FUSION REACTORS. Frank, T.; Dudziak, D.; Heck, E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 16p. (CONF-740402-13). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The results of initial neutronics calculations for conceptual laser-fusion power reactors are presented. Extensive calculations were done for a basic reactor model with a 4-m-diam. spherical cavity and a 1-m-thick lithium blanket region. Important neutronic characteristics were evaluated in parametric studies for other reactor sizes of interest. Niobium was assumed as the structural material; however, limited calculations were also done for systems with molybdenum structural components. The principal results include determinations of breeding ratios, energy deposition densities, primary neutron-damage effects, and induced radioactivity and afterheat. (auth)

6314 (LA-UR-74-593) CONCEPTUAL LASER CONTROLLED THERMONUCLEAR REACTOR POWER PLANT. Williams, J.; Merson, T.; Finch, F.; Schilling, F.; Frank, T. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 16p. (CONF-740402-16). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The design of a conceptual 1000-MW(e) laser-fusion power plant is presented. Twenty-four reactor cavities, based on the wetted-wall concept, are included in this facility. Fusion pellets producing 100 MJ of thermonuclear energy release per microexplosion are ignited by 1-MJ laser pulses at the rate of 1.2 per second in each of the reactor cavities. Laser pulses are provided by a central laser system which serves all reactor cavities and which is based on short-pulse CO_2 laser technology. Important considerations which led to design choices included component reliability, redundancy of essential components, access to components for service and/or replacement, and minimization of hazards from radioactive materials. (auth)

6315 (LA-UR-74-594) POTENTIAL LASERS FOR LCTR APPLICATIONS. Gilbert, J. S.; Stratton, T. F.; Jensen, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 21p. (CONF-740402-14). Dep. NTIS $4.25.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Laser performance requirements for conceptual laser controlled thermonuclear reactor power plants are reported. Several lasers that may eventually satisfy the requirements for laser-fusion power plants are discussed. An electron-beam-controlled discharge CO_2 laser power amplifier conceptual design for producing 125 kJ output in pulses of ~1-ns duration is described. (auth)

6316 (LA-UR-74-608) EFFECT OF Be(n, 2n) MULTIGROUP TREATMENT ON THETA-PINCH BLANKET NUCLEONICS. Soran, P. D.; Dudziak, D. J.; Muir, D. W. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 14p. (CONF-740402-15). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Changes in the tritium breeding ratio, displacements per atom of structural material, and other important neutronic parameters as a result of the multigroup treatment of the Be(n,2n) reaction, are calculated for a reference theta-pinch fusion reactor blanket configuration. Tritium breeding ratios vary by 6% depending upon the treatment of the energy and angular distributions of the $^9Be(n,2n)$ secondary neutrons. Additional significant changes in other neutronic parameters for a Reference Theta-Pinch Reactor (RTPR) are presented. (auth)

6317 (LA-UR-74-611) TRANSMUTATION AND ATOM DISPLACEMENT RATES IN A REFERENCE THETA-PINCH REACTOR. Dudziak, D. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 26p. (CONF-740402-30). Dep. NTIS $4.50.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

In the system studies for theta-pinch reactors, neutronic calculations were performed to determine reaction rates which may induce changes in material properties. Determination of primary effects such as displacements per atom (dpa), interstitial helium production, and transmutations is an essential first step in forecasting secondary effects (e.g., changes in ductility, dimensional stability, surface properties, electrical properties), even though the capability to do such prediction is currently in a primitive state. Sources of data for appropriate response functions are discussed, and calculational results presented for a 2.0 MW/m^2 wall loading of 14.1-MeV neutrons (total neutron flux of $9.04 \times 10^{18} m^{-2} s^{-1}$). Resulting reaction rates in the niobium of the first wall are 18 dpa/y, 59 ppM He/y, and >0.3a/o transmutation per year; in the graphite maximum values are 12 dpa/y, 1,240 ppM He/y, and ~0.06a/o transmutation per year. (auth)

6318 (LA-UR-74-616) HEAT TRANSFER THROUGH A REFERENCE THETA-PINCH REACTOR (RTPR) COOLING LAYER. Oliphant, T. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 10p. (CONF-740402-36). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The effects of finite mean free path on classical thermal conductivity have been discussed for RTPR conditions. The net result is that the cooling layer will be a bit denser than previously expected. Also, the transient effects of charge exchange processes between the neutral gas cooling layer and the main plasma are discussed. It is shown how the main plasma can be shielded from the incident neutrals thus reducing the wall damage which might occur as a result of bombardment by high-energy neutrals. (auth)

6319 (LA-UR-74-617) ERGONIC OPTIMIZATION AND PARAMETER STUDY OF THE RTPR BURN CYCLE. Krakowski, R. A.; Oliphant, T. A.; Thomassen, K. I. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 17p. (CONF-740402-21). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The Reference Theta-Pinch Reactor (RTPR) must operate within constraints imposed by the requirements of plasma ignition and plasma quench. These constraints are quantitatively identified and a parameter study is made within these constraints on the influence of oxygen impurity and subsystem efficiencies on the Q-value (thermal power/recirculating power). The energy replacement time for the implosion heating circuit and the efficiency of magnetic energy transfer are varied as a function of the compression field risetime, the magnitude of the compression field, and the length of the thermonuclear burn. A wide range of viable operation of the RTPR with the parameter space considered is demonstrated. (auth)

6320 (LA-UR-74-629) COMPARATIVE ANALYSIS OF D–T FUSION REACTOR RADIOACTIVITY AND AFTERHEAT. Dudziak, D. J.; Krakowski, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 21p. (CONF-740402-18). Dep. NTIS $4.25.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Induced radioactivity and afterheat in fusion reactor blanket structures and magnetic coils are essential inputs for environmental impact studies. These quantities were calculated for a Reference Theta-Pinch Reactor (RTPR) and compared with reported results for other fusion reactors and typical fast fission reactors. Major independent variables considered in the RTPR analysis were structural material (Nb-1%Zr, V-20%Ti), neutron wall loading (0.2 to 6.7 MW/m^2), operating time (1 to 20 y) and time after shutdown (0 to 30,000 y). For a given operating time, large radioactivity contributions from ^{95}Nb render higher Ci/Wt and Ci/Wt y values at higher wall loadings and <1 y after shutdown. At long times after shutdown this dependence is reversed and represents an advantage relative to long-term radwaste storage. Activity from V-20%Ti is very insensitive to wall loading or operating time. For either material, afterheat power densities are about two orders-of-magnitude lower than for fission reactors. (auth)

6321 (LA-UR-74-640) FUSION REACTOR APPLICATIONS OF THE HIGH-DENSITY LINEAR THETA PINCH. Ellis, W. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 15p. (CONF-740402-19). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Machine parameters are calculated for five potential linear theta-pinch applications of interest, i.e., (1) a confinement experiment to achieve the Lawson criterion; (2) a power-producing theta-pinch reactor; (3) a power-producing laser-heated reactor; (4) a radiation and materials test facility (FERF); and (5) a fusion/fission hybrid reactor. General scaling laws are derived with the magnetic field strength as the independent variable. Comparisons are drawn, where appropriate, between toroidal and linear theta-pinch design concepts. (auth)

6322 (LA-UR-74-652) MATERIALS PROBLEMS IN MAGNETICALLY CONFINED PULSED FUSION REACTORS. Green, W. V.; Yeske, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 6p. (CONF-740222-1). Dep. NTIS $4.00.

From symposium on engineering for the materials/energy challenge; Albuquerque, New Mexico, USA (28 Feb 1974).

The materials problems are discussed from an engineering viewpoint. The mechanical response of structural metals in the Reference Theta Pinch Reactor is described. Thermal stresses, grain boundary cracks, and other failures are discussed. (MOW)

6323 (MATT-1032) DATA ACQUISITION SERVICES AT PPPL. Thompson, P. A.; Slusky, S. G.; Bennett, F. K.; Greenberger, A. J. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Apr 1974. Contract AT(11-1)-3073. 16p. Dep. NTIS $4.00.

The current status of DAS-1800, the data acquisition system built around an IBM-1800 computer, is reported; hardware and software developments allowing the concurrent servicing of ST, FM-1, and ATC are described; and details are given of the changes in usage of DAS-1800 during the some three and a half years of its existence. Finally, plans are discussed for providing similar data acquisition services for PLT when it starts operation in less than two years. (auth)

6324 (MATT-1035) REVISED VERSION OF THE ANISN CODE. Price, W. G. Jr. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Apr 1974. Contract AT(11-1)-3073. 23p. Dep. NTIS $4.25.

PPL-ANISN is a revised version of the ANISN discrete ordinates transport theory code. It features several improved input options and a provision for binary output of its principal results. (auth)

6325 (TID-26550) SUPERCONDUCTING MAGNETS AND CRYOGENICS AS APPLIED TO FUSION REACTORS. File, J. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1972. Contract AT(11-1)-3073. 28p. Dep. NTIS $4.50.

A review of superconductivity research is presented. The discussion concerns mainly type-II superconductors. Some materials and their properties are discussed in relation to the fusion program. (MOW)

6326 (UCID-16466) TWO COMPONENT FERF. Fowler, T. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Mar 1974. Contract W-7405-eng-48. 17p. Dep. NTIS $4.00.

The possibilities of using a two-component mirror facility as a Fusion Engineering Research Facility are discussed. The advantages for obtaining higher neutron flux levels are described. The physics of the system is described. (MOW)

6327 (UCRL-75286) SHOCK WAVE INTERACTIONS ARISING FROM NEAR SURFACE DISPLACEMENT CASCADES. Guinan, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1974. 29p. (CONF-740104-21). Dep. NTIS $4.50.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

Kaminsky has observed that during 14-MeV neutron irradiation of a variety of materials substantial micrometer-sized particles are ejected from the surfaces of the bombarded specimens. Similarities between Kaminsky's observations and the macroscopic phenomena of spall suggest the possibility that shock waves and transient thermal stresses, generated by energetic primary knockons, may be responsible. Spall phenomena are discussed briefly as background to calculations of the shock wave interactions. The results indicate that cascade generated stresses may be responsible for the emission of such particles by triggering the release of stored internal energy. (auth)

6328 (UCRL-75176) BLANKET THERMAL ENERGY CONVERSION SYSTEM FOR A MIRROR MACHINE. Peterson, M. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Oct 1973. Contract W-7405-eng-48. 6p. (CONF-731114-53). Dep. NTIS $4.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A preliminary design study of a blanket energy conversion system for a "Yin–Yang" field geometry mirror machine is presented. This system utilizes a dc electromotive pump of an unusual geometry to circulate the liquid lithium coolant through a blanket formed by an array of tubular flow passages. The spatial geometry of the tubular array is such that the MHD-induced pressure drop in the lithium is kept to acceptable levels, and blanket thicknesses and compositions consistent with adequate neutronic performance are maintained. Adjacent layers of the blanket tubular array are connected by plenum chambers located in both mirror regions to form closed lithium circulation loops. The pumping power required is low (typically ½% of the blanket thermal power). The plenum chambers also function as heat exchangers with the helium secondary working fluid. (auth)

6329 (UCRL-75303) MAGNET DESIGN FOR A FUSION ENGINEERING RESEARCH FACILITY. Pittenger, L. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1974. Contract W-7405-eng-48. 8p. (CONF-740402-34). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The conductor layout for the magnet for a device to generate a plasma of thermonuclear parameters is described. Shielding and access considerations place restrictions on the layout not normally encountered in experimental magnets. The coil cross-section is made to vary along the current path in order to reduce conductor surface induction to tolerable levels for Nb–Ti and Nb_3Sn superconductor. The final result is a coil with a minimum-B field shape which permits adequate access for plasma refueling by neutral particle injection. (auth)

6330 (UCRL-75304) NEUTRONICS ANALYSIS OF A 2500 MW_{th} FAST FISSION NATURAL URANIUM BLANKET FOR A DT FUSION REACTOR. Lee, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1974. Contract W-7405-eng-48. 11p. (CONF-740402-32). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Subcritical fast fission blankets fueled with natural uranium and natural lithium are found to be capable of generating 100 to 200 MeV while breeding 1.1 tritons per fusion neutron. Such blankets appear capable of extended operation without refueling, their lifetime limited only by material damage problems. Up to at least 20 percent uranium burnup, calculated blanket performance is higher than at 0 burnup. (auth)

6331 (UCRL-75306) WALL BOMBARDMENT DUE TO THE CHARGE EXCHANGE OF INJECTED NEUTRALS WITH A FUSION PLASMA. Carlson, G. A.; Hamilton, G. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1974. Contract W-7405-eng-48. 12p. (CONF-740402-28). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

An analysis of the interaction of an injected neutral beam with a fusion plasma is presented. Neutral particles bombard the first

wall due to penetration through the plasma and charge exchange collisions between the injected neutrals and the plasma ions. The analysis yields the distribution of neutral particle flux density and power density incident on the first wall as functions of the angle relative to the beam axis, the injection energy, the plasma energy distribution, and the beam attenuation through the plasma. The analysis includes the important effect of reionization of the charge exchange neutrals. Two example applications of the analysis demonstrate that under certain conditions charge exchange and penetration can result in large currents and current densities of neutral particles which bombard the walls of mirror machines. (auth)

6332 (UCRL-75307) MAGNETOHYDRODYNAMIC PRESSURE DROP OF LITHIUM FLOWING IN CONDUCTING WALL PIPE IN A TRANSVERSE MAGNETIC FIELD: THEORY AND EXPERIMENT. Carlson, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1974. Contract W-7405-eng-48. 10p. (CONF-740402-29). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

A review is given of the theory of fully developed, laminar flow of an incompressible, electrically conducting fluid in a conducting-wall, circular pipe when the direction of flow is perpendicular to a uniform magnetic field. A simple, approximate formula for the magnetohydrodynamic pressure gradient is presented, and it is shown that it can be made to agree with a more exact solution provided that the multiplicative factor in the approximate formula is allowed to vary with C and CH, where C is the pipe wall to fluid electrical conductance ratio and H is the Hartmann number. A lithium loop experiment is described which verifies the theoretical prediction for the MHD pressure drop over a range of parameters which encompasses the expected fusion reactor applications of flowing lithium. (auth)

6333 (UCRL-75418) OUTLOOK FOR FUSION ENERGY SOURCES: REMAINING TECHNOLOGICAL HURDLES. Post, R. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Mar 1974. 26p. (CONF-740213-6). Dep. NTIS $4.50.

From one hundred fortieth meeting of The American Association for the Advancement of Science; San Francisco, California, USA (25 Feb 1974).

Controlled fusion research is now in its third decade. Through this effort most of the critical scientific issues for the main approach to fusion—magnetic confinement—have been resolved. Remaining critical scientific questions are mainly quantitative in nature, and have to do with residual instabilities of the confined fusion plasma. The status of the research is such that there is a strong basis for believing that these questions will be satisfactorily answered in the next 8 to 10 years, to the point that fusion based on magnetic confinement could be assured of success. Laser fusion, much newer on the scene, also has critical quantitative issues to resolve, issues that will be addressed in the next few years. Despite the fact that fusion reactors do not yet exist much of the technology that will be required for fusion reactors is perforce being developed to satisfy the demanding needs of the scientific phase. Through this entree into fusion technology we can begin to visualize fusion reactors, their unique features (vis a vis other power generation means), and their technological problems. As power sources they would have many advantages, both environmentally and operationally (particularly in lowered hazard potential) over conventional nuclear power. Their unique problems would seem to be those associated with vacuum problems, i.e., with protection of the reacting plasmas from contamination, with plasma heating and refueling, and with plasma chamber wall deterioration under neutron or charged particle bombardment. These issues appear difficult, but solvable, by design and materials choices. Their resolution will probably set the time scale for the practical realization of fusion power following the completion of the scientific phase. It is therefore important to pursue now the technological issues, in parallel with the present scientific studies, to move the advent of fusion power to the earliest possible date. (auth)

6334 (UCRL-75622) HEAT FLUX LIMITATIONS ON FIRST-WALL SHIELDS FOR EARLY FUSION MACHINES. Hoffman, M. A.; Werner, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1974. Contract W-7405-eng-48. 14p. (CONF-740402-31). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Methods for producing convective heat transfer systems having high thermal heat flux capability are discussed. It is shown that given sufficient flow velocity heat fluxes as high as ~6 KW/cm^2 are possible. The limiting values are determined by thermal stress. Pressure drop and pumping power are significantly high in order to achieve the high flux values. Critical heat flux (burnout) is not limiting. The materials examined are Al, Nb, Mo, stainless, V, T, and Ta. Water is the coolant. Application is for the first wall of a fusion reactor designed as a high neutron flux test facility. (auth)

6335 TOROIDAL APPARATUS FOR CONFINING PLASMA. Ohkawa, T. (to United States Atomic Energy Commission). US Patent 3,801,438. 2 Apr 1974. Filed date 3 Apr 1970. 8p.

A toroidal apparatus is described for confining plasma in which at least three magnetic field producers are provided. One field producer provides a toroidal magnetic field. Another field producer provides a multipolar configuration for the toroidal field. A third field provides rotational transform for the multipolar magnetic field. All of the field producing means are outside of the toroidal confinement region. (Official Gazette)

6336 STATUS OF FUSION RESEARCH. Troppmann, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1972). vp. (In German).

From information meeting of the Max-Planck-Institut fuer Plasmaphysik; Garching, Germany (7 Nov 1972).

A short state-of-the-art survey stressing the main problems in D–T fusion programs is presented. Topics discussed include laser triggered plasmas, magnetic mirrors and other confinement schemes as well as a few remarks on the Lawson diagram and costs. (GE)

6337 LOW-LEVEL BETA PROGRAM OF THE IPP. Grieger, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1972). vp. (In German).

From information meeting of the Max-Planck-Institut fuer Plasmaphysik; Garching, Germany (7 Nov 1972).

The discussion concerns the Tokamak and stellarator principle. Main problems arise from diffusion of particles and energy loss which are both compensated by injection of energetic neutral particles or clusters. The heating is primarily done by Ohmic heating and supplemented by high-frequency heating at higher temperatures. (GE)

6338 TOROIDAL APPARATUS FOR CONFIRMING PLASMA. Ohkawa, T. (to United States Atomic Energy Commission). US Patent 3,801,438. 2 Apr 1974. Filed date 3 Apr 1970. 8p.

A toroidal apparatus is described for confining plasma in which at least three magnetic field producers are provided. One field producer provides a toroidal magnetic field. Another field producer provides a multipolar configuration for the toroidal field. A third field provides rotational transform for the multipolar magnetic field. All of the field producing means are outside of the toroidal confinement region. (Official Gazette)

6339 NEW DOUBLE-PATH STELLARATOR DESIGN. Lanilkin, I. S.; Shpigel, I. S. (Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 50-64(1973). (In Russian).

A number of requirements are formulated for toroidal systems. A new double-path stellarator design is proposed which is capable of satisfying these requirements. The new system differs from preceding designs in the high stability of the field configuration as to structural errors and has improved properties which ensure confinement of plasma and individual particles. The design of the system gives ready access to the working volume and provides excellent vacuum conditions, as well as having light mechanical loading of the most complicated elements of hardware. (Referativnyi Zh.)

6340 CALCULATION OF WALL HEATING FOR PINCHED DISCHARGES. Wheeler, C. B. (Imperial Coll. of Science and Tech., London). J. Phys., D (London); 7: No. 4, 546-550(1 Mar 1974).

The plasma current and wall temperature distributions are evaluated in the precollapse phase using a one-dimensional representation of the current and thermal diffusion equations. It is assumed that the plasma electrical conductivity and the time derivative of the total current are both constant in this early stage of the discharge. The great advantage of a metallic wall construction over a nonmetallic one is immediately obvious from the dependence of wall heating on the physical properties of the wall material. Finally, the calculations are applied to estimate the rise in wall surface temperature during the precollapse phase of documented linear, theta and toroidal pinches. (auth)

6341 NUCLEAR FUSION RECENT DEVELOPMENT. Boffa, C. (Istituto di Fisica Tecnica, Turin). Termotecnica (Milan); 28: No. 3, 134-139(Mar 1974). (In Italian).

The basic nuclear fusion processes are described and the most suitable reactions are indicated for the utilization of nuclear fusion as an energy source of the future. The major problems en-

countered in this respect are discussed, together with their possible solutions. Various devices are described that are likely to be used in the future for energy production from thermonuclear fusion. (auth)

6342 TOR-2 STELLARATOR. Ivanovskii, M. A.; Popov, S. N.; Popryadukhin, A. P. (Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 65-72(1973). (In Russian).

The difference between the Tor-2 stellarator and others is that the magnetic field is set up by discrete elliptical coils rather than by helical windings. Theoretical assumptions are given which act as the basis for the design of the installation, and also the results of initial studies. (Referativnyi Zh.)

6343 INVESTIGATION OF THE MAGNETIC FIELD STRUCTURE OF THE TOR-1 AND TOR-2 STELLARATORS. Andryukhina, E. D.; Ivanovskii, M. A.; Popov, S. N.; Popryadukhin, A. P.; Fedyanin, O. I.; Khol'nov, Yu. V. (Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 73-81(1973). (In Russian).

The electron beam method was used to study the structure of magnetic surfaces in toroidal plasma traps with a double-helix field i.e., the Tor-1 and Tor-2 stellarators. Beam monitoring was done by the conventional probe method and by a high-speed dielectric grid method. It is shown that the structure of the surfaces is regular up to angles of rotational conversion i of the order of 5.5π throughout the entire range of variation in i with the exception of the resonance values $i = \pi, 2\pi, 4\pi$, for which expansion of the surfaces with the formation of a rosette structure is recorded. The amplitude of resonance perturbations measured with respect to the width of the rosettes is of the order of 10^{-4} of the amplitude of the main stellarator field. (Referativnyi Zh.)

6344 STUDY OF THE x-RAY PRODUCTION MECHANISM OF A DENSE PLASMA FOCUS. Johnson, D.J. (Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico 87117). J. Appl. Phys. 45: No. 3, 1147-1153 (Mar 1974).

The x-ray emission from a 375-kJ plasma focus is reported as measured on a time-resolved basis with Ross filters and silicon diode detectors. Thick-target electron beam spectra are calculated with a Monte Carlo electron beam transport program and fit to the experimental time-integrated x-ray spectra. A good fit is obtained with a 2-MA E^{-2} power law electron beam, with cutoff energies at 8 and 200 keV, incident normal to a thick tungsten target. The source of the beam is judged to be electrons which are accelerated under the influence of strong electric fields. A 20-nsec Q-switched ruby laser pulse injected tungsten ions via laser ablation prior to the initial dense pinch, and the x-ray emission below 4 keV was enhanced and that above 10 keV was reduced. The enhanced low-energy x-ray emission is in agreement with calculated radiation for collisional M-shell excitation of highly stripped tungsten in a 1.5-keV thermal plasma. A 900- μsec ruby laser pulse injected sufficient tungsten ions to degrade greatly the initial dense plasma pinch and reduce the beam target x-ray emission. The time-resolved x-ray emission from this configuration appeared as a smooth Gaussian function in time with FWHM ~ 200 nsec. (auth)

6345 MAGNETIC FIELD OF A STELLARATOR WITH A PLASMA CURRENT. Volkov, E.D.; Sebko, V.P.; Tyupa, V.I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 5, 612-614 (Nov 1973).

An analysis is made of the effect of a longitudinal plasma current on the structure of the magnetic surfaces in a stellarator. It is shown that in the case of an exponential (or parabolic) radial distribution of the longitudinal current (such a distribution has been detected experimentally in the Sirius stellarator) the magnetic surfaces can be changed significantly. As the plasma current is increased, resonance regions appear and the magnetic surfaces are destroyed at a certain critical current. The calculated results agree qualitatively with experiments carried out on the Sirius stellarator. (auth)

6346 PERFORMANCE OF THE ALL-METAL-WALL THETA PINCH. Naraghi, M. (Arya-Mehr University of Technology, Tehran, Iran). Appl. Phys. Lett. 24: No. 8, 360-362 (15 Apr 1974).

An all-metal-wall theta pinch has been constructed by stacking 200 anodized aluminum rectangular rods in order to form a cylindrical shell. Measurements by magnetic probes have shown the separation of current sheet from the metal wall in cases where the potential difference between two adjacent rods has been 25 V. Temperature measurements in helium plasma have shown higher temperatures when metal is used rather than dielectrics. (auth)

Wave Phenomena

Refer also to abstracts 6296 and 6300.

6347 (CEA-R-4538) NONLINEAR STOCHASTIC THEORY OF THE INTERACTION OF AN ELECTRON-ION PLASMA WITH AN INTENSE ELECTROMAGNETIC WAVE. Masselot, C. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). 1974. 114p. (In French). Dep. NTIS (US Sales Only) $8.75.

Thesis. Submitted to Paris Univ., Orsay.

The interaction of an electron-ion plasma with a strong high frequency electromagnetic field was studied using the Stratonovitch stochastic method. The hierarchy of the equations obtained was broken using a power expansion of a small dimensionless parameter. The solution of this set of equations leads to the computation of the spectral densities, density fluctuations, dynamic friction, and diffusion terms of the equation describing the behavior of the one particle distribution function. (auth)

6348 (ITF-73-145-E) NONLINEAR FREQUENCY SHIFT TAKING INTO ACCOUNT DIFFUSION IN VELOCITY SPACE. Falk, L.; Kocherga, O. D. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 12p. Dep. NTIS (U.S. Sales Only) $4.00.

The resonant interaction of four longitudinal plasma waves was investigated taking into account the influence of wave field on the background distribution function. It was found that the correction to the nonlinear frequency shift due to this effect is essential. Langmuir waves in a cold plasma are considered as an example. (auth)

6349 (NP-19980) PHYSICS DISCIPLINE. Annual Progress Report, 1972. (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences). Dec 1972. 74p. Dep. NTIS (US Sales Only) $6.75.

Research being conducted in the field of plasma physics includes topics such as wave propagation, high-β plasmas, shock waves and plasma theory. In atomic physics collision processes between electrons and atoms/molecules are being investigated; other topics include gas breakdown and electron transport. Theoretical nuclear physics is centred on the three-nucleon problem. Studies include nd reactions, (p,2p) reactions and Faddeev approach to the pion two-nucleon system. (AT)

For title listings of selected papers see: 7963-7965.

6350 (SLA-73-1071) COMPARISON OF SOME THEORIES OF RADAR BACKSCATTERING BY TURBULENT PLASMA WITH APPLICATION TO CLUTTER CALCULATIONS. Brown, W. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). May 1974. Contract AT(29-1)-789. 20p. Dep. NTIS $4.00.

The backscattering of radar by turbulent ionized gas in a nuclear environment appears to make an important contribution to radar clutter. It is customary to use the first Born approximation in computing this backscattering. Other methods of computing radar backscattering, such as a Born-eikonal approximation, which treats the ensemble-averaged properties of the turbulent plasma in an eikonal approximation and the fluctuating properties in a perturbation expansion, and a stochastic transport theory, which is similar to radiation transport theory, are described. These methods are compared with the Born approximation in the context of a nuclear environment, and numerical results obtained with a model of a turbulent ionized gas are presented. (auth)

6351 UNIFORM MAGNETOPLASMA WAVEGUIDE. Sodha, M. S.; Sharma, R. P.; Tripathi, V. K. (Indian Inst. of Tech., New Delhi). J. Phys., D (London); 7: No. 6, 866-870(11 Apr 1974).

It is seen that an electromagnetic beam of arbitrary radial intensity distribution propagates in a magnetoplasma in the extraordinary and ordinary modes without convergence or divergence when $\omega_p^2/\omega^2 = (1-\omega_c/\omega)/(1-\omega_c/2\omega)$ for the extraordinary mode, and $\omega_p^2/\omega^2 = (1+\omega_c/\omega)/(1+\omega_c/2\omega)$ for the ordinary mode. A beam having a radial distribution of amplitude $J_0(\beta_0 r)$, however, always propagates in a uniform waveguide mode. (auth)

6352 PROPAGATION OF ELECTROMAGNETIC WAVES THROUGH TURBULENT PLASMA USING TRANSPORT THEORY. Fante, R. L. (Air Force Cambridge Research Lab., Bedford, MA). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP-21: No. 5, 750-755(Sep 1973).

Transport methods were employed to study the propagation of a narrow-angle electromagnetic beam through a turbulent plasma. Results are presented for the mean-square angular divergence of the beam, the beam cross section, and the power received by a planar aperture in the medium and the mutual coherence function. The problem of backscattered radiation is also considered and results are obtained which reduce, in the limit of zero true absorption, to previous results. (auth)

6353 ELECTROMAGNETIC WAVE SCATTERING BY PLASMA CONTAINERS. Sharma, S. C. (Birla Inst. of Tech. and Science, Pilani, India). Def. Sci. J. (New Delhi); 23: No. 3, 121-128(Jul 1973).

The scattering cross section is derived by an approximate

method for a thin plasma plate and for thin spherical and conical shells. The computed results for scattering cross-section for a plate and spherical and conical shells are obtained. The results are presented in the form of scattering cross-section aspect angle plane. (auth)

6354 INFLUENCE OF COLLISIONS ON THE INCOHERENT SCATTERING SPECTRUM OF A LASER BEAM BY A MAGNETICALLY CONFINED AND UNMAGNETIZED PLASMA. Louet, C.; Leclert, G.; Mayer, R. L. (Univ., Nancy). Plasma Phys.; 16: No. 6, 527-531(Jun 1974). (In French).

The spectrum produced by incoherent scattering of an electromagnetic wave by plasma was studied, both for magnetically confined and unmagnetized plasma. Electron–neutral collisions only were included, and treated using the theory of Hagfors and Brockelman. The results in the unmagnetized case showed a narrowing of the spectrum and an increase in the non-Doppler shifted power scattered. For magnetized plasma the electron-cyclotron resonances weakened with increasing collision frequency. In the highly collisional limit the spectrum became similar to that without a magnetic field. The results were applied to a possible laboratory experiment. (auth)

6355 WAVE TRANSFORMATION ON THE PLASMA BOUNDARY IN A STRONG MAGNETIC FIELD. Benkhabib, F.; Kondratenko, A. N. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 1, 150-151(Jan 1974). (In Russian).

The semi-confined plasma existing in a strong magnetic field perpendicular to the boundaries at which the electromagnetic waves impact obliquely was examined. The electric vector of the waves lies in the impact plane. If the wave frequency is close to the Langmuir frequency then longitudinal waves arise in the plasma. The field of longitudinal waves and the transformation coefficient of the electromagnetic waves in the longitudinal waves were calculated in the kinetic approximation during diffusion reflection of the electrons at the boundary. During diffusion reflection the transformation coefficient is smaller than during mirror reflection. (tr-auth)

6356 DISPERSION RELATION FOR PARALLEL–PLANT WAVEGUIDE CONTAINING TRANSVERSELY MAGNETIZED UNIAXIAL AND WARM PLASMA IN A RELATIVE MOTION. Jain, P. K.; Singh, D.; Gupta, P. N.; Tolpadi, S. K. (Banaras Hindu Univ., India). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP-21: No. 5, 743-744(Sep 1973).

Starting from the dispersion relation corresponding to TM modes in the rest system and relativistic transformations, a dispersion relation corresponding to the TM mode, is derived in the moving system. The plasma is assumed to be homogeneous, compressible, and uniaxial in the presence of strong TM field. From the wave equation corresponding to TE modes in the moving system, it is concluded that the dispersion relation corresponding to TE modes is independent of the temperature of plasma and is the same as that for ordinary air-filled parallel-plane waveguide in the presence of strong TM field. The magnetic field has no effect on air filled guide. The dispersion relation corresponding to TEM modes is also derived. (auth)

6357 SUM-RULE ANALYSIS OF COLLECTIVE MODES IN A TURBULENT PLASMA. Ichimaru, S.; Tange, T. (Department of Physics, University of Tokyo, Bunkyo-ku, Tokyo, Japan). Phys. Rev. Lett. 32: No. 3, 102-104 (21 Jan 1974).

An explicit relationship between the dispersion relations of collective modes and the energy spectrum of turbulent fluctuations is derived from a sum-rule analysis of the dielectric response function. It is pointed out that turbulence produces significant modification in the dispersion relation so that an experimental investigation of such an effect offers a promising method of probing a turbulent plasma. (auth)

6358 LINEAR TRANSFORMATION OF WAVES IN AN INHOMOGENEOUS PLASMA. Davydova, T. A. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 12, 2040-2048(Dec 1973). (In Russian).

A new method of wave transformation investigation is proposed. The F-matrix method is developed which was proposed by N. Fröman and P. O. Fröman for investigation of the WKB-approximation to a second order differential equation. By means of this method the possibility is investigated of the existence of localized solutions of the 4th order equation describing the interaction of two different types of waves in a plasma and the character of the conjugation formula joining the solutions on different sides of the band of interaction is determined. (auth)

6359 HIGHER ORDER MODES AND ELECTRON BURSTS IN PROPAGATION OF ELECTRON PLASMA WAVES BOUNDED PLASMA. Sugai, H.; Sato, N.; Saeki, K.; Hatakeyama, R. (Tohoku Univ., Sendai). Plasma Phys.; 16: No. 5, 485-487(May 1974).

Propagation and damping of plasma waves were studied experimentally especially on electron plasma and in acoustic waves. In general there exists an infinite number of modes with different radial and azimuthal wavenumbers which can propagate along a cylindrical plasma column. Thus it is not always correct to neglect the contribution of the higher modes. Measurements of both higher modes of electron plasma waves and electron bursts generated by different types of exciter (probe, ring, and plate) were prevented on a strongly magnetized sodium plasma in a single-ended Q-machine. (UK)

6360 DISPERSION PROPERTIES OF PLASMA IN SHOCK TUBES. Tusnov, Yu. I. Izv. Tomsk. Politekh. Inst.; 213: 128-134(1972). (In Russian).

The dependence of plasma permittivity in shock tubes on the frequency was studied. The variation of the complex coefficient of reflection of an electromagnetic wave from a plasma moving along a coaxial tube in argon is measured in the range of shock wave velocities of V = 2.0 to 3.2 km/s (Mach number M = 6 to 10) for initial pressures p = 2.5 and 10 mm Hg, and in air for V = 2.8 to 4.1 km/s (M = 8 to 12), p_0 = 5 and 10 mm Hg. The measured variation with frequency showed satisfactory agreement with the theoretical calculations in ionized air at temperatures of 3 to 5 × 10^{3}°K and argon temperatures of 4 to 10 × 10^{3} °K in the frequency range of 200 to 7300 MHz. (Referativnyi Zh.)

6361 ADDITIONAL STUDIES OF RF PLASMOIDS. Goforth, J.H.; Miller, A. (New Mexico State University, Las Cruces, New Mexico 88001). J. Appl. Phys. 45: No. 3, 1474-1475 (Mar 1974).

Data have been obtained that support the belief that the particular form of the static-electric-potential profile that arises when negative ions are present in an rf plasmoidal discharge is necessary for the formation of dark-sheath plasmoids. In addition, ethanol and acetone vapors have been found to yield visible emission spectra containing the prominent lines of the CO^{+} comet tail system which readily reveal dark-sheath plasmoid characteristics. Pure water-vapor discharges do not exhibit dark-sheath plasmoids, but in the presence of air impurities the conditions necessary for the formation of a dark sheath apparently arise when the relative intensity of the O_2^{+} spectrum is large enough. (auth)

6362 OBSERVATION OF TEMPORAL ECHOES IN A MIRROR–CONFINED PLASMA. Chatelier, M.; Lecoustey, P.; Samain, A. (Association EURATOM–Commissariat á l'Energie Atomique sur la Fusion Département de Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, 92260 Fontenay–Aux–Roses, France). Phys. Rev. Lett. 32: No. 7, 366-369 (18 Feb 1974).

Compressional magnetic pulses with frequencies near the ion bounce frequency have been applied to the plasma of a mirror machine. One pulse induces at first order a balistic effect, and at second order an irreversible effect corresponding to a variation of the parallel energy. A second pulse applied after a convenient delay time produces a temporal echo which provides an estimate of the diffusion rate of the magnetic moment of the particles. (auth)

6363 TRANSFORMATION, TRANSMISSION, AND REFLECTION OF WAVES IN A PLASMA WITH A TANGENTIAL VELOCITY DISCONTINUITY. Lupanov, G.A. (N. I. Lobachevskii Gor'kii State University). Sov. Phys.–Tech. Phys. 18: No. 5, 587-590 (Nov 1973).

An electromagnetic wave incident on the boundary between a moving plasma and a plasma at rest (equal densities) is analyzed. The transmission and reflection of this wave and the transformation into a plasma wave are studied. The plasma is described by relativistic hydrodynamic equations which are used, in particular, to obtain boundary conditions. The relativistic approach is used because, even in the weakly relativistic approximation, at low temperatures, quadratic terms in the velocity must be retained in the final equations. The case of normal incidence is studied in detail: It is shown that the amplitude transformation coefficient reaches a maximum value (of order unity) under the condition $v^2/c^2 \sim (1-\omega^2_p/\omega^2)$ (where v is the discontinuity in the plasma velocity at the boundary, and ω_p is the plasma frequency). The energy transformation coefficient, however, is not large, being approximately of order v_T/c(where v_T is the electron thermal velocity). Oblique incidence is also studied in detail in the approximation of low translational velocities and low temperatures; the basic distinguishing feature of this case is that for incidence tangent to the boundary ($|\pm\pi/2-\theta| \sim v_T/c$, where θ is the angle of incidence) the energy transformation coefficient can approach unity. (auth)

6364 CONVERSION OF AN OBLIQUE WAVE AT THE BOUNDARY OF A MAGNETOACTIVE PLASMA. Kondratenko, A.N.; Onishchenko, I.N. (A. M. Gor'kii Khar'kov State University). Sov. Phys.–Tech. Phys. 18: No. 5, 598-602 (Nov 1973).

A linearly polarized wave is obliquely incident on a semiinfinite plasma located in a constant magnetic field which is perpendicular to the boundary. If the wave frequency is close to the plasma or ion-acoustic frequencies, longitudinal waves are excited in the plasma. The coefficients for the transformation of high-frequency and low-frequency transverse waves into longitudinal waves are calculated.

Despite the fact that a magnetic field perpendicular to the boundary does not change the motion of particles along the normal to the boundary, which is most important in boundary-value problems, anisotropy of the medium leads to an effect which is qualitatively different from that which occurs in an isotropic plasma. A wave with electric vector perpendicular to the plane of incidence excites longitudinal waves in a magnetoactive plasma in contrast to the case in an isotropic plasma. The transformation coefficients for high-frequency waves in a magnetoactive plasma are considerably greater than for an isotropic plasma. (auth)

6365 PENETRATION OF A HIGH-FREQUENCY LONGITUDINAL FIELD INTO A NONEQUILIBRIUM PLASMA. Kalmykova, S.S. (A. M. Gor'kii Khar'kov State University). Sov. Phys.-Tech. Phys. 18: No. 5, 603-606 (Nov 1973).

A study is made of the one-dimensional problem of the transformation of a regular charge-density wave that propagates along an electron beam when it enters a plasma half-space. It is shown that in the general case the determination of the Fourier amplitude of the field in the plasma reduces to solving a boundary-value problem with analytic functions. In the limiting case of a monoenergetic low-density beam explicit expressions are obtained for the amplitudes of the longitudinal beam and plasma waves excited at the plasma boundary. (auth)

6366 ABSORPTION OF AN ELECTROMAGNETIC WAVE AT HARMONICS OF THE ELECTRON GYROFREQUENCY IN AN INHOMOGENEOUS MAGNETOACTIVE PLASMA. Golovanivskii, K.S.; Castro Blanco, J. (Patrice Lumumba University of International Friendship, Moscow). Sov. Phys.-Tech. Phys. 18: No. 5, 673-675 (Nov 1973).

The conversion of an electromagnetic wave into Bernstein resonant modes, which are highly damped when their frequencies coincide with one of the harmonics of the electron gyrofrequency, is described. An incident wave is absorbed by an inhomogeneous plasma if the plasma contains a region accessible to the electromagnetic wave in which the electron density lies in the range $(0.75\text{–}1)n_{cr}$, where n_{cr} is the critical density. The damping efficiency depends slightly on the harmonic number. It is found experimentally that there is a threshold electron density for the appearance of absorption bands at the second and third harmonics. The experiments are carried out with the TE_{11} mode in a cylindrical waveguide containing a hydrogen plasma in which the electron collision frequency is small. (auth)

6367 FAST ION-ACOUSTIC WAVE IN A MULTICOMPONENT PLASMA. Pasechnik, L.L.; Semenyuk, V.F. (Institute of Nuclear Research). Sov. Phys.-Tech. Phys. 18: No. 5, 676-678 (Nov 1973).

An experimental study has been made of low-frequency oscillation $\omega_{Hi} < \omega < \omega_{He}$, where ω_{Hi} and ω_{He} are the ion and electron gyrofrequencies, respectively, in the plasma of a capacitive high-frequency discharge. These oscillations result from the propagation of an axisymmetric fast ion-acoustic wave nearly perpendicular to the magnetic field. In accordance with the theory of Fried et al., several principal longitudinal modes having different phase velocities can exist in a multicomponent plasma. It is also shown that in a plasma containing ions differing markedly in mass, the oscillation spectrum due to the light ions becomes predominant when these light ions comprise only a few percent of the total number of ions. (auth)

6368 NONLINEAR TRANSFORMATION OF ELECTROMAGNETIC WAVES AT THE BOUNDARY OF A MAGNETOACTIVE PLASMA. Kondratenko, A.N.; Shaptala, V.G. (A. M. Gor'kii Khar'kov State University). Sov. Phys.-Tech. Phys. 18: No. 5, 671-672 (Nov 1973).

Calculations are performed on the interaction of a linearly polarized wave with the boundary of a magnetoactive plasma. (AIP)

6369 PARAMETRIC EXCITATION OF SURFACE WAVES IN AN INHOMOGENEOUS MAGNETIZED PLASMA. Aliev, Y.M.; Gradov, O.M.; Zyunder, D. (M. V. Lomonosov Moscow State University). Sov. Phys.-Tech. Phys. 18: No. 5, 621-624 (Nov 1973).

A study is made of the stability of an inhomogeneous plasma layer in an rf electric field and constant magnetic field. A dispersion relation is obtained and from it the threshold values of the rf field above which an external wave decays into longitudinal high-frequency and low-frequency surface modes with a phase velocity exceeding the thermal velocity. An expression is given for the growth rate near threshold. (auth)

6370 WAVEGUIDE PROPERTIES OF A PLASMA CYLINDER FOR AXIALLY ASYMMETRIC MODES. Kurilko, P.I.; Shvets, O.M.; Ovchinnikov, S.S. (Physicotechnical Institute, Academy of Sciences of the USSR, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 6, 728-730 (Dec 1973).

The waveguide properties of a cylindrical plasma rod with a uniform density distribution over the cross section are considered. Expressions are found, in the hydrodynamic approximation, for the field components of an axially asymmetric mode with a single azimuth variation; the dispersion equation of this mode is found. The solutions of this equation in the region of low, ion-cyclotron frequencies show that there exists an axially asymmetric ion-cyclotron wave whose transverse field components are characterized by a slow radial variation. This wave is of interest for high-frequency plasma heating. Calculations are also given of the nonreciprocity effect (variation of the energy flux in the wave with the direction of propagation) for a series of realistic parameter values. (auth)

6371 CONVERSION OF ELECTROMAGNETIC WAVES TO ELECTROSTATIC WAVES IN INHOMOGENEOUS PLASMAS. Stenzel, R.L.; Wong, A.Y.; Kim, H.C. (TRW Systems, Redondo Beach, California 90278, and Department of Physics, University of California at Los Angeles, Los Angeles, California 90024). Phys. Rev. Lett. 32: No. 12, 654-657 (25 Mar 1974).

Propagation of electromagnetic waves in a large plasma reveals that refraction effects are much more significant than the amplitude swelling commonly predicted from the reduction in group velocity. Near electromagnetic wave cutoff, direct conversion into short-wavelength electron plasma waves is observed. Strong resonant enhancement of the electric field parallel to the density gradient is measured. (auth)

6372 OBSERVATIONS OF ION-ACOUSTIC CYLINDRICAL SOLITONS. Hershkowitz, N.; Romesser, T. (Department of Physics and Astronomy, University of Iowa City, Iowa City, Iowa 52242). Phys. Rev. Lett. 32: No. 11, 581-583 (18 Mar 1974).

Cylindrical solitons are seen to evolve from compressive cylindrical pulses in a collisionless plasma. The properties of these solitons are found to be consistent with the known properties of one- and three-dimensional solitons. (auth)

6373 ACOUSTIC INSTABILITY OF A BOUNDED SLIGHTLY IONIZED PLASMA. Ganefel'd, R.V.; Panasevich, L.L. (Institute of Electrodynamics, Academy of Sciences of the USSR). High Temp. 11: No. 2, 354-356 (Nov 1973).

The homogeneous plasma approximation is used to carry out a two-dimensional analysis of acoustic instability in a subsonic plasma flow (AIP)

ENGINEERING

Energy Conversion

Refer also to abstracts 6814 and 8888.

6374 (EUR-CEA-FC-724) EQUILIBRIUM PROBLEMS IN MAGNETOHYDRODYNAMICS. Bouligand, G. M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jan 1974. 22p. (In French). Dep. NTIS (US Sales Only) $4.25.

In local domains, MHD systems generally admit Euclidian solutions which can be extended to infinity. Nevertheless, difficulties arise when topographical conditions are imposed, thus implying a periodicity, i. e., closing of isobaric surfaces. Overall solutions are thus sought. In Euclidian space, helicoid symmetry generalizes symmetry of revolution and leads to solutions having restrictions. An attempt is made to discover the orgin of overall equilibrium properties using less restricted equations. In this way, the Hamada coordinate system can be introduced using a metric tensor. This leads to the existence of overall equilibria in Riemann spaces. Without involving small momenta changes, it is shown that the energy principle can be extended to Riemannian spaces using gradient, divergence, and curl operators and that the reduction of a Riemannian space into a Euclidian space does not in any way alter the stability and instability predictions. (FR)

6375 (RT/FI-(73)42) IONIZATION INSTABILITY IN A MAGNETIZED LOW TEMPERATURE PLASMA AND ITS INFLUENCE ON THE ELECTRICAL CONDUCTIVITY OF NONEQUILIBRIUM PLASMA IN MHD GENERATORS. Zampaglione, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 29 Nov 1973. 182p. Dep. NTIS (US Sales Only) $12.25.

The plasma stability analysis has become one of the main fields of physical research on gaseous magnetohydrodynamic generators, as nonuniformities in the plasma properties may significantly impair output and efficiency of energy conversion. A review and discussion are given of the up to date investigations (with special reference to the theoretical analysis) on the plasma nonuniformities due to the onset of ionization instability in a weakly ionized low temperature gas placed in electric and magnetic fields and on their relevant effects on the performance of nonequilibrium MHD generators. (auth)

6376 (UCRL-75600) REVIEW OF DIRECT ENERGY CONVERSION OF ION BEAMS: EXPERIMENTAL RESULTS AND REACTOR APPLICATIONS. Moir, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Apr 1974. 18p. (CONF-740402-23). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

In order to produce neutral beams for fusion reactors efficiently, the energy carried by the unneutralized portion of the ion beam may have to be recovered in a direct converter. Several concepts applicable to beam direct conversion are discussed. The concept that has received the most attention uses planar sets of grids. One experimental test with a hydrogen ion beam at 2 keV and 0.1 W cm^{-2} gave an efficiency of 95%. Another experiment at 20 keV and 200 W cm^{-2} was limited by gas-pressure effects to about 70% efficiency. The loss mechanisms and such design constraints as power density, space charge, and secondary electron emission are discussed. (auth)

6377 ESTIMATION OF THE INFLUENCE OF A FINITE CORE LENGTH OF THE MHD MACHINE ON ITS EDGE EFFECT. Vol'dek, A. I.; Manoilova, O. N.; Tolvinskaya, E. V. Magn. Gidrodin.; No. 4, 111-116(1973). (In Russian).

On the basis of the one-dimensional theory a numerical evaluation is given of the effect of the finite core length of the inductor on the parameters of the conversion circuit of induction machines with consideration of the longitudinal edge effect. A comparison is made of the calculated resistance of the edge effect for four variants of the edge zone. (tr-auth)

6378 APPROXIMATION OF THE CONDUCTIVITY OF WALLS IN PROBLEMS ON THE LONGITUDINAL END EFFECT IN INDUCTION CHANNELS. Kirillov, I. R. Magn. Gidrodin.; No. 4, 117-122(1973). (In Russian).

An approximation of the conductivity of walls in problems on the longitudinal end effect in induction channels is made on the basis of averaging the electromagnetic fields according to the gap heights. The results of the calculation of the integral characteristics from the dependences obtained is compared with the results of approximation calculations where the effect of the wall is considered by the equivalent magnetic Reynolds numbers taken from the solution of the problem for infinitely long induction MHD machines. (tr-auth)

6379 MHD: A REALISTIC CONTRIBUTION TO SOLVING THE ENERGY CRISIS. Cryog. Ind. Gases; 9: No. 1, 15-18 (1974).

The economics and feasibility of coal-fired MHD plants for electric power production are reviewed. (TFD)

6380 MHD ENERGY CONVERSION: PRESENT DEVELOPMENT PROGRAMS AND GASEOUS FISSION REACTOR APPLICATIONS. Rosa, R. J. (Avco Everett Research Lab.). pp 28-30 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From second symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

A brief review of present research being conducted at Avco Everett on MHD generators is given. Testing facilities to simulate a large-scale machine are briefly discussed. The control of effluents is also discussed. (MOW)

6381 SIGNIFICANCE OF PROPERTIES OF WORKING MEDIA IN TECHNICAL APPLICATIONS. Bayer, Z.; Malesak, J.; Preis, J. (Ustav Termomechaniky, Prague). Strojnicky Cas.; 24: No. 2-3, 198-208(21 Nov 1972).

The significance is discussed of the physical properties of working media, mainly for power and chemical engineering. The effect of individual properties of working media is demonstrated by the liquid metal MHD generator cycle, by the thermal cycle with high molecular substances and with dissociating nitrogen tetroxide. The significance of relaxation phenomena for the advanced technology is discussed. (auth)

6382 PROSPECTS OF THE MAGNETOHYDRODYNAMIC ELECTRIC POWER GENERATION. Rev. Electrotec.; 59: No. 1, 16-22(Jan 1973). (In Spanish).

The aspects of MHD electric power generation which are of greatest interest in the formulation of a power policy are summarized. The present objectives of studies on power production and the principal lines of research are reviewed. MHD generation and its adequacy in fulfilling power needs are discussed. The experimental equipment at the National Observatory of Cosmic Physics is described. (tr-auth)

6383 ELECTROGASDYNAMIC GENERATION USING SOLID-GAS SUSPENSION IN TURBULENT PIPE FLOW. Ho, K.; Coffee, R.A. (Electrical Engineering Department, University of Hong Kong, Hong Kong). J. Appl. Phys. 45: No. 3, 1135-1143 (Mar 1974).

The paper describes a study of the charge transfer of a solid-gas suspension in turbulent pipe flow. Using hollow glass spheres as the particulate phase, nitrogen and saturated air respectively as the gaseous phase, experiments were performed at flow rates of Reynolds number 5000-16000. Experimental results reveal that along a dielectric pipe there is strong electrification of the suspension, with particle electrification per pipe-diameter displacement of the order of -10^{-5} C/kg, while along a conductor pipe the charge decay of the electrified suspension is of an empirical form $(q/m)_0 \exp(-\alpha l^{1/2})$, where l is the suspension displacement from the pipe entrance and α is a constant. In each case the pipe length was approximately 1 m, and the internal diameter approximately 1 cm. The process of charge transfer through particle-pipe impact is discussed, and an experimental EGD generator setup is described. (auth)

6384 DYNAMIC CHARACTERISTICS OF A PLASMA DIODE IN THE LOW-VOLTAGE ARC MODE. II. EXPERIMENTAL INVESTIGATION OF THE DYNAMIC CHARACTERISTICS. Lidorenko, N.S.; Loshkarev, A.I.; Bondarenko, V.D. (None). Sov. Phys.-Tech. Phys. 18: No. 6, 763-768 (Dec 1973).

The results of an experimental investigation of the dynamic characteristics when the output voltage varies harmonically and the load changes discontinuously are given. In agreement with the theory developed in ref. 1, effects of immediate stabilization of the dynamic characteristics are observed. The stabilization frequency increases with increasing degree of development of the arc. At large perturbation amplitudes specific nonlinear effects begin to appear: frequency multiplication, departure of the dynamic characteristic from the initial point of the static one, etc. When the load changes discontinuously, a number of characteristic segments can be isolated on the dynamic characteristics that are related to the relative contribution of spatial recombination and ionization. The dynamic characteristics reveal new

possibilities for diagnosing the internal parameters of thermionic converters. The use of stabilized dynamic characteristics makes it possible to determine the effective work function of the cathode. Good agreement is obtained between the values of the effective work function for a niobium cathode in cesium vapor when the cathode temperature and cesium–vapor pressure are varied, and the results of independent measurements made by other authors. (auth)

6385 CURRENT FLOW THROUGH BOUNDARY LAYERS (E). Baranov, V.Y.; Malyuta, D.D.; Ulinich, F.R. (Kurchatov Institute of Atomic Energy). High Temp. 11: No. 3, 411-419 (Jan 1974).

Theoretical and experimental studies are presented for the electrode fall in potential when there is a cold boundary layer; the effects of microscopic arcs on the gas-dynamic parameters are examined for the channel of an MHD generator. (auth)

6386 SUPERHEATING INSTABILITY IN A FLOW OF AN INCOMPRESSIBLE, ELECTRICALLY CONDUCTING MEDIUM UNDER CONDITIONS OF THE INTERNAL BOUNDARY-VALUE PROBLEM. Khait, V.D. (Institute of High Temperatures, Academy of Sciences of the USSR.). High Temp. 11: No. 3, 420-425 (Jan 1974).

Superheating instability in the channel of a MHD generator with consideration of a drop of electrical and thermal conductivity at the wall is investigated. Curves of neutral stability are obtained for various values of the parameters of the boundary layers. (auth)

6387 CHARACTERISTICS OF A NONEQUILIBRIUM MHD GENERATOR. Buznikov, A.E.; Vanin, V.E.; Kirillov, V.V. (Institute of High Temperatures, Academy of Sciences of the USSR.). High Temp. 11: No. 3, 554-561 (Jan 1974).

Results are presented on a nonequilibrium magnetohydrodynamic generator working with an argon-potassium plasma; the measurements have been made in the range of Hall numbers β,1.5–25, with the electron temperature differing from the gas temperature, in accordance with $T_e/T_g = 1.1$–1.8, and an electron temperature $T_e = 1800$–$2800°K$, for various values of the relative wall temperature $\bar{T}_w = T_w/T_e$; it is found that the ionization instability and imperfection in the electrical insulation in the channel affect the characteristics of the generator, as do nonuniformities in the conductivity of the nonequilibrium plasma near the electrodes. An approximate model is given for estimating the characteristics of a nonequilibrium MHD generator on the basis of these three effects. The calculated and measured results are found to be in good agreement throughout the range of parameters employed. (auth)

6388 EXPERIMENTAL STUDY OF THE OPERATION OF A POROUS ELECTRODE IN AN MHD CONVERTER WITH THE INJECTION OF POTASSIUM-CONTAINING ARGON. German, V.O.; Kukota, Y.P.; Lyubimov, G.A.; Parfenov, B.V.; Poltavtseva, I.S.; Sleptsov, V.M.; Shchegolev, G.M. (Institute of Technical Thermophysics, Academy of Sciences of the Ukrainian SSR.). High Temp. 11: No. 3, 562-567 (Jan 1974).

The results of an investigation into the discharge on the porous zirconium diboride electrode of an MHD converter are considered. Argon containing a potassium additive (~1 wt.% Ar) is blown through the permeable surface of the electrode. The apparatus and procedure employed for the experiments are described. It is shown that, under arc-free conditions, a current density of 10–15 A/cm² may be taken from the cathode for a cathode drop of 20–50 V and a working surface temperature of 1200–1600°C. The results are discussed from the point of view of their use in an open-cycle MHD generator. (auth)

6389 DISTRIBUTION OF THE POTENTIAL AND MAGNETIC FIELD IN AN OPTIMAL PLANE MHD GENERATOR. Medin, S.A.; Farber, N.L. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 11: No. 2, 340-344 (Nov 1973).

The variation problem of the distribution of the potential in a MHD generator with a uniform flow characterized by maximum power for given values of the electrical efficiency and magnetic flux in the channel is considered. The magnetic induction is positive and bounded above. The solution of the problem has an edge extreme with respect to the magnetic field. Induction takes on the maximum allowable value at the end section of the channel where power takeoff with a constant current density at the electrodes also occurs. The characteristics of such a generator are compared with the characteristics of an optimal generator with continuous electrodes. (auth)

6390 ANALYSIS OF THE ELECTRICAL EFFICIENCY OF AN INDUCTION MHD GENERATOR AT SMALL MAGNETIC REYNOLDS NUMBERS. Krylova, L.M. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 11: No. 2, 345-348 (Nov 1973).

The interaction of a gas flow given in the form of an electrical conductivity wave in the channel of an induction MHD generator with a constant magnetic exciting field and field of a given electrical circuit is investigated at small magnetic Reynolds numbers. The values of the electrical efficiency of the interaction are determined as a function of the parameters of the electrical circuit and distribution of the loops of this circuit along the MHD channel, boundary conditions for the magnetic field at the channel exit, and electrical conductivity waveform. (auth)

Facilities and Equipment

Refer also to abstracts 7442, 8744, and 8828.

6391 (CEA-CONF-2570) FISSURE EFFECTS IN COMPARISON ON VESSELS UNDER PRESSURE. Dore, A.; Foglia, S.; Lebey, J.; Tomachevsky, E. (Electricite de France, 41 Saint-Laurent-des-Eaux). 1973. 15p. (In French). (CONF-730942-6). Dep. NTIS (US Sales Only) $4.00.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A comparative study was made of the rupture behaviour of three AMMO steel spherical vessels of different dimensions under pressure. Two stress levels were determined for each sphere. The first is a stress of fissure initiation and the second causes the rapid propagation of the fissure. The results are in good agreement with previous tests made on other steels. (JSR)

6392 (CEA-CONF-2571) ANALYSIS OF SHELLS OF ANY FORM IN THE PLASTIC REGION BY THE FINITE ELEMENT METHOD. Hoffmann, A.; Livolant, M.; Roche, R. (Krupp (Friedr.) G.m.b.H., Essen (F. R. Germany). Forschungsinstitut). 1973. 24p. (In French). (CONF-730942-5). Dep. NTIS (US Sales Only) $4.25.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A simplified model of the total plasticity of a shell element is derived from the general Timochencko model by using the generalized Von Mises criterion. The simplified model is used in the COCO and TRICO programs of the POCO system. The treatment of the plasticity in TRICO is outlined. Some applications of the model to circular plates, elbows with circular cross sections, elbows with elliptical cross section, and reactor slabs are illustrated. (JSR)

6393 (CONF-730942-P5, pp vp Paper M 2/4) HERMITIAN RECTANGLE FINITE ELEMENT FAMILY. Hartig, D. (Technische Hochschule, Darmstadt, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The paper deals first with two problems of element subdivision and element form. It is shown, how full continuity of function and normal derivative can be obtained in cases where a node of a smaller element meets an adjacent larger element, e.g., in the middle of two corner nodes. This technique is based on simple interpolation. The values of function and normal derivative depend linearly on the nodal values. By these equations the continuity between adjacent elements of different size can be obtained. This leads to a great flexibility for the subdivision. In this way it is easy to refine a grid step by step in a manner which assures monotonic convergence of the solution. It makes also more attractive the Hermitian Sector Element, which is fully compatible at its straight sides with the Hermitian Rectangle. Right triangular boundary elements are derived by imposing boundary conditions along a diagonal of the rectangular element. The conditions of zero value of function or normal derivative can be formulated exactly, the condition of zero value of function and normal derivative approximately. In the second part of the paper the described techniques are applied to some functionals for plate and shell problems. Thermal stress problems in which the solution in some points is singular. The behavior of the Hermitian Element is studied. Thermal stresses and thermal buckling of plates with temperature-dependent material properties and plate bending problems, demonstrating the application of the techniques of A1 and A2, are discussed. Shell problems, formulated by a functional of the normal deflection and Airy's Stress function, are discussed. Elements for this functional are derived with Hermitian Polynomials of third and of fifth order. The application of this functional is limited, but in cases where it works the results are very good. (auth)

6394 (CONF-730942-P5, pp vp Paper M 2/5) SIMPLE "MIXED" METHOD FOR PLATE- AND SHELL PROBLEMS. Giencke, E. (Technische Univ., Berlin). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Plates and shells normally will be analyzed by the finite element method specially by the deformation method. In this case, the most interesting interior forces and moments will be obtained as

differences of the unknown deformations, which yield to a great loss in accuracy. To avoid such a loss in accuracy, the interior forces and the strains will be introduced as unknowns. The stretching forces n_x, n_y, n_{xy}, the stretching strains ϵ_x, ϵ_y, ϵ_{xy}, the moments m_x, m_y, m_{xy}, and the curvatures k_x, k_y, k_{xy} are described. These forces and strains as well as the geometrical curvatures of the shell and the loads are approximated linearly from point to point. The structure can be divided into triangular and rectangular elements. The interior forces and the strains do not satisfy the equilibrium and compatibility conditions, therefore, equilibrium and compatibility equations have to be formulated as in a mixed method. This will be done by means of the principles of virtual work, but in a very simple manner, for example as virtual displacements rigid body motions of the elements will be chosen. In this case the interior forces work only along the gridlines as in a grid of beams. Thus it is quite simplified to establish the equations. By using the duality between plate-bending and -stretching the effort of computer programming is reduced. Both problems are treated with the same program, which only needs to be slightly extended for the application to shallow shells. In the case of the deformation method the stiffness matrices for plate-stretching and -bending have unfortunately a quite different structure and it is difficult to develop for double curved shells simple stiffness matrices with unrestrained rigid body motions of the elements. Furthermore, the stretching- and bending-stresses have different approximations and they are discontinuous at the boundaries of the elements. Here each stress and strain has the same approximation with no discontinuities at the boundaries of the elements. Results are shown for stress concentration problems in plates and shells with holes and cut-outs. (auth)

6395 (CONF-730942-P5, pp vp Paper M 2/6) CONVERGENCE OF FINITE ELEMENT SCHEMES BASED ON NONCONFORMING AND SIMPLIFIED HYBRID DISPLACEMENT METHODS. Kikuchi, F.; Ando, Y. (Tokyo Univ.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The examples of finite element schemes to which the present theory may be applicable are: (1) Rectangular finite element for plane stress problems proposed by R. H. Gallagher: In this scheme, the displacements are approximated by non-conforming quadratic polynomials which satisfy homogeneous equations of equilibrium in each element. (2) Triangular finite element for plate bending by Fujino and Morley: The lateral deflection is approximated by non-conforming quadratic polynomials. This scheme is equivalent to the mixed one proposed by Herrmann. The convergence of the well-known ACM non-conforming scheme may be established by the combined use of the present theory and Miyoshi's techniques with his error estimations improved. In these examples, it is generally observed that the consistency conditions are not easily verified in non-conforming schemes, while the stability ones are difficult to check in hybrid displacement schemes. (auth)

6396 (CONF-730942-P5, pp vp Paper M 2/7) CONVERGENCE OF LUMPED FINITE ELEMENT SCHEMES FOR SELECTED INITIAL VALUE PROBLEMS. Kikuchi, F.; Ando, Y. (Tokyo Univ.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the finite element analysis of dynamic systems, the evaluation of inertia force is usually made by the employed shape function itself, while that of stiffness is done by the spatial derivatives of the shape function. This fact considerably increases the complexity in calculation of mass matrices (or conductivity in the case of heat equation). Therefore, lumping is often made to overcome such shortcomings of the consistent formulation and to reduce the bandwidth of the mass matrices. Its theoretical justification is, however, not yet sufficient in general forms except in some very simple finite element schemes. Therefore, the aim of this paper is to propose general criteria for convergence of lumped finite element schemes for selected initial value (or mixed initial-boundary value) problems. For this purpose, the result obtained by Tong et al. in eigenvalue problems is very helpful. It is also to be noted that the lumping in the present discussion means that of the employed finite element basis, and not that of the consistent matrices calculated. The finite element schemes discussed here are the modified Faedo-Galerkin schemes in which the dynamic forces are evaluated by lumped basis. In order to assure the convergence of the schemes, one must impose as criteria some relations between the consistent and lumped expressions of the same deflection field. These conditions consist of equivalence of norms of both expressions, which is necessary to assure the stability of the schemes, and some consistency or completeness conditions for shape functions. Then, the convergence of the schemes can be easily derived by utilizing fundamental techniques in functional analysis. Some care should be taken in choosing lumped expressions so as not to reduce the convergence rates of original consistent schemes. It is especially to be noted that the proposed criteria are usually satisfied in popular conforming shape functions of the polynomial type. (auth)

6397 (CONF-730942-P5, pp vp Paper M 2/8) FINITE ELEMENT ELASTOPLASTIC ANALYSIS BY QUADRATIC PROGRAMMING: THE MULTISTAGE METHOD. De Donato, O.; Maier, G. (Politecnico, Milan). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Recent studies have shown that the quadratic programming approach to the elastoplastic analysis of structures may be competitive with respect to the well-known iterative asymptotical solution procedures (such as "tangent-modulus", "initial strain", "initial stress") for discretized elastoplastic systems. When loads increase proportionally, local unloading phenomena can be conjectured to be either absent (regular progressive yielding) or immaterial. Then holonomic (reversible) law can be assumed and, through a suitable piecewise linearization of the hardening or perfectly plastic constitutive laws, the problem can be solved in finite terms as a single convex quadratic programming problem by some standard technique. The quadratic programming approach for finite element models of elastoplastic continua subjected to non-proportional loading path, i.e., to significant local unloading phenomena, is developed. The nonproportional loading path is subdivided into a set of individually proportional stages. The structural response to each loading stage is determined by solving a convex quadratic program formulated on the basis of a suitable piecewise linearization of the constitutive laws. As in all other approaches, the path-dependency of the plastic behavior is not allowed for within each loading step. However, in passing from one stage to the subsequent one, the irreversible nonholonomic nature of plastic deformations is fully allowed for, simply by a suitable adjustment of the piecewise linear constitutive laws to be assumed for the subsequent stage. The determination of the structural response to each loading step is formulated as a quadratic programming problem in two alternative ways: in the former the unknowns are the nonnegative plastic multipliers which govern the additional plastic strains developed in the step; in the latter the unknowns are the above plastic multipliers and the additional displacements. The two formulations are compared both from the theoretical and from the computational standpoint. The extension of both formulations to cases where geometry changes affect significantly the equilibrium relations is pointed out. The method is applied to some plane stress and plane strain problems whose solutions by other approaches are available, so that comparisons become possible and are made. The quadratic programming solutions are achieved by an algorithm with finite termination (Beale's) and by a modified conjugate gradient method, and the two techniques are compared to each other. (auth)

6398 (CONF-730942-P5, pp vp Paper M 2/9) FINITE ELEMENT METHOD AND LOCAL BOUNDS FOR BOUNDARY VALUE PROBLEMS OF ELASTIC STRUCTURES. Schomburg, U. (Technische Hochschule, Aachen). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

As the numerical results for elastic structures are in general approximate it is desirable to have bounds for the unknown stresses or displacements. Using a Hilbert space where every state of a linear elastic structure is associated with an element of this space, global bounds for an unknown state are easy to obtain, if two approximate or comparison states are known. To solve variational problems, a finite element method is established using elements which are able to satisfy prescribed inhomogeneous boundary conditions exactly. It is then shown that the finite element analysis can be nearly synchronized: the final two systems of algebraic equations differ only on the right hand side. Therefore, it is only necessary to set up one coefficient matrix and to invert it once. The computational work for local bounds is not much more than that for global bounds. Several numerical examples are given. (auth)

6399 (CONF-730942-P5, pp vp Paper M 2/10) THREE-DIMENSIONAL ELASTIC FINITE ELEMENT ANALYSIS USING GRADIENT DEGREES OF FREEDOM. Shatoff, H. D. (Gulf General Atomic Co., San Diego, CA). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The advantages of higher polynomial order elements in which the higher order nodal degrees-of-freedom are also incorporated are pointed out. These degrees-of-freedom are the gradients of

the displacement fields of the zeroth and first orders. Other than the advantages offered by the higher order element itself, there is the opportunity of producing a "mixed" system in which both linear and higher order elements are involved at the same time to represent different areas of the structure. The selection of element order depends on the severity of the displacement field variation. Without changing any of the basic data, an initial analysis using all simplex elements may be changed to a "mixed" analysis by designating modeling elements as higher order in highly stressed regions. The natural elements to use as a basis for such a scheme are the simplex or linear element which is a tetrahedron in its three-dimensional form with the three zeroth order displacement gradients at each of its four nodes (the displacements themselves) and corresponding truncated cubic element which contains the three zeroth order displacement gradients along with the nine first order displacement gradients at each node. Transition elements with both the three and twelve degree-of-freedom nodes are required to retain compatibility of the displacement fields. A complete set of the required linear, cubic and transition elements are presented for three dimensions. They may easily be developed for one and two dimensions also. The element form used is a tetrahedron in the three-dimensional case. Derivations for both flat surfaced and curved surfaced tetrahedrons are presented. Preliminary numerical results are shown in the present compact version of the full paper which will be published at some future date. (auth)

6400 (CONF-730942-P5, pp vp Paper M 3/1) NONSAP: A GENERAL FINITE ELEMENT PROGRAM FOR NONLINEAR DYNAMIC ANALYSIS OF COMPLEX STRUCTURES. Bathe, K. J.; Wilson, E. L. (Univ. of California, Berkeley). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The recently developed very effective computer program NONSAP for the nonlinear static and dynamic analysis of complex structures in presented. The program is very flexible and was designed to be extended and modified by the user. In particular, realizing that active research is still being carried out in the field of nonlinear dynamic analysis, the program can easily be modified to use a different formulation of the equations of motions, different (new) time integration operators and other additional options. The program, therefore, is an excellent research tool, but, in particular, with the specific formulation and time integration operator currently used, it has proven to be very powerful in a variety of practical analyses. In the first part of the paper, the incremental formulation currently used in the program is briefly reviewed. Specifically, recent experiences with problems of accuracy and stability of the formulation are discussed. It is realized that, in a dynamic analysis, an equilibrium iteration can be very important. Attention is also briefly directed to the current possibilities of representing the stress-strain relationships of various materials. The general program organization is presented next. The program is an in-core solver. The capacity of the program is essentially determined by the total number of degrees of freedom in the system. However, there is practically no limit on the total number of finite elements used. In the solution, low-speed storage is used to store all information pertaining to the finite elements, which may be updated in each time step, and to store the constant structure matrices. To obtain maximum program capacity, the finite elements are processed in blocks according to their type and whether they are linear or nonlinear elements. The linear structure matrices (stiffness, mass and damping) are assembled in sequence using the same high speed storage before the time integration is performed. In each time step the effective stiffness matrix and the effective load vector are updated for the nonlinearities present in the system. All matrices are stored in compacted form, i.e. only nonzero elements are processed, resulting into maximum system capacity and solution efficiency. The specific scheme used to assemble the matrices in compacted form and to solve the resulting system equations is briefly described in the paper. Program NONSAP has application in the nonlinear analysis of many different structures. Various sample solutions are presented to show typical analyses and solution times. (auth)

6401 (CONF-730942-P5, pp vp Paper M 3/5) NONLINEAR FINITE ELEMENT ANALYSIS OF REINFORCED CONCRETE PLATES. Berg, S.; Bergan, P. G.; Holand, I. (Univ. of Trondheim, Norway). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A numerical method of analysis for reinforced concrete plates is presented. Material and geometric nonlinearities are included in the computational model so that the behavior may be followed up to the ultimate carrying capacity of the plate. An arbitrary combination of transverse and on inplane loading may be applied to the plate. The method permits the analysis of plates of arbitrary geometric form. The computational model can account for several layers of reinforcement bars, each of which may have a separate orientation. Any stress-strain diagram may be used for the steel bars. The nonlinear stress-strain relationship for the concrete is accounted for using numerical representation of the results of biaxial tests. Crack initiation in the concrete is considered using experimental failure envelopes. The Kirchhoff assumptions for thin plates are adopted. Large deflection effects are introduced utilizing the von Karman strain expressions. Equilibrium and incremental equations accounting for the effects described above are given for the plate. The general quadrilateral finite elements used in the numerical solution include both inplane and out-of-plane displacements. The stiffness relations for each element are computed numerically by integration based on a set of discrete points distributed over the area and through the thickness of the element. The total system of elements is solved incrementally by applying the external loads in steps. Iterations are also carried out to assure that equilibrium is maintained. The state of stress is checked at every integration point for each loading step and the material properties at these points are updated accordingly. At points where the cracking limit has been exceeded, cracking is introduced following the direction perpendicular to the axis of the principal tension stress. Previous cracking is memorized. Computational examples showing the displacements and development of crack patterns in moderately thick concrete slabs are included. Good agreement with experimental results is demonstrated. It is further shown that the geometrical nonlinerities have a significant effect on the behavior at high levels of loading. (auth)

6402 (CONF-730942-P5, pp vp Paper M 3/6) SPECIAL FINITE ELEMENTS FOR FLAW AND DISCONTINUITY STRESSES IN COMPOSITES. Patil, S. S. (Indian Inst. of Science, Bangalore); Rao, A. K.; Raju, I. S. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Fiber-reinforced composites are one of the most significant recent developments in structural concepts. The discontinuities and flaws in such composites require careful understanding and study. Analysis of this problem without special, ab initio, attention to the nature of local concentrations is found to lead to erroneous results in continuum methods and requires large computer capacity and computing times in the finite element methods. In the standard finite element method, there is a further disadvantage that the elastic stress concentration is not properly identified in the immediate vicinity of the discontinuity or flaw. The special finite elements and the hybrid technique provide a powerful tool which overcomes all these inadequacies of the other methods. Special elements for use with line fibers and some applications to typical problems are presented. The method is used for analyzing a wide range of problems including elastic fibers, stresses at fiber breaks etc. It can be applied to many otherwise intractable problems. (auth)

6403 (CONF-730942-P5, pp vp Paper M 3/8) FINITE ELEMENT ANALYSIS OF A THICK WALLED MICROPOLAR CYLINDER LOADED AXISYMMETRICALLY. Baluch, M. H. (Tennessee State Univ., Nashville); Korman, T.; Morghem, F. T. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Numerous researchers have used the technique of the finite element method in obtaining the stress and displacement field in various bodies subjected to loadings and based on the theory of classical elasticity. In recent years, there has been a revived interest in the field of microelasticity, with Eringen and his coworkers and Mindlin formulating the theory of micromorphic solids independently. Subsequently, Eringen formulated the theory of micropolar elasticity which involves a microdisplacement field in addition to the macrodisplacement field of classical elasticity. It appears that the theory of micropolar elasticity better simulates the behavior of some structural materials as opposed to the classical theory of elasticity. Based on this concept, the application of the micropolar theory, in the form of a finite element approach, to an infinitely long thick-walled concrete cylinder subjected to an internal pressure is presented. The problem considered is in a state of plane strain and use is made of a stiffness matrix for triangular elements formulated earlier by Baluch and his co-workers for micropolar materials in a state of plane strain. Micropolar materials in a state of plane strain have four physical, or material, constants which include the two Lame' constants, λ and μ, and two additional constants, χ and γ, due to the microstructure of the medium. Commonly used values for the modulus of elasticity E and

Poisson ratio ν for concrete are used to establish the Lame' constants and experimental results of Bradfield, Pursey and Kroner are used to determine χ and γ. The stress field is determined for a range of values of the physical constants and the effects of the micropolar structure on the behavior of the thick-walled concrete cylinder is studied by comparing the results with those as obtained by using the classical theory of elasticity. (auth)

6404 (CONF-730942–P5, pp vp Paper M 3/9) CONVECTED COORDINATES FOR TRANSIENT NONLINEAR FINITE-ELEMENT ANALYSIS. Belytschko, T. (Univ. of Illinois, Chicago); Hsieh, B. J.; Kennedy, J. M. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the transient dynamic finite-element analysis of structures and continua, a key prerequisite for large-scale analyses is an efficient computational scheme. Many of the nonlinear dynamic programs currently available, such as, for example, those of J. A. Stricklin et al., and J. F. McNamara and P. V. Marcal, employ Lagrangian descriptions. Hence, the treatment of geometric nonlinearities requires the use of nonlinear stress-strain relations. In flexural elements, where numerical integration is needed for the computation of nodal forces, these nonlinear terms require considerable computational effort. Hence, these programs are relatively time consuming and the size of problems that can be analyzed is quite restricted. A transient finite-element procedure which uses convected coordinates that rotate with the elements is described. These convected-coordinate procedures were first described for static analysis in the pioneering works of J. H. Argyris et al. However, particularly in the U. S., their usage has been quite limited. Yet the convected-coordinate formulation is especially suited to transient problems, for it simplifies the finite-element relations and consequently results in considerable efficiency. The method presented is a variation on the method first presented by Argyris. For problems with small strains but arbitrarily large rotations, it is shown that the relations between strains in the convected coordinates and what are termed deformation displacements are completely linear. Similarly, the relations between nodal forces and element stresses are linear. The nonlinearities that arise from large rotations are treated entirely by the transformations between the elements' convected coordinates and the global coordinates. The method has been applied to beams and continua in two dimensions, axisymmetric shells and continua, and plates in three-dimensional space. Sample results for all of these problems will be presented and compared with available numerical and experimental results. A major feature of this method is its computational efficiency. On an IBM 370/195, the speed ranges from 1500 to 3000 element steps per second, depending on the element. (auth)

6405 (CONF-730942–P5, pp vp Paper M 5/1) REVIEW OF CONTINUUM, FINITE ELEMENT, AND HYBRID TECHNIQUES IN THE ANALYSIS OF STRESS CONCENTRATIONS IN STRUCTURES. Rao, A. K. (Indian Inst. of Science, Bangalore). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

When a uniform flow of any nature is interrupted in any way, the readjustment of the flow results in concentrations and rarefactions, so that the peak value of the flow parameter will be higher than what an elementary computation would suggest. When stress flow in a structure is interrupted, there are stress concentrations. These are generally localized, and often large, in relation to the values indicated by simple equilibrium calculations. With the advent of the industrial revolution, dynamic and repeated loading of materials had become common place in engine parts and fast moving vehicles of locomotion and this led to serious fatigue failures arising from stress concentrations. Also, many metal forming processes, fabrication techniques and weak-link type of safety systems benefit substantially from intelligent use or avoidance, as appropriate, of stress concentrations. As a result, in the last eighty years, the study and evolution of stress concentrations has been a premier objective in the study of solid mechanics. Exact mathematical analysis of stress concentrations in finite bodies presents considerable difficulty for all but a few problems of infinite fields, concentric annuli and the like, treated under the presumption of small deformation, linear elasticity. A whole series of techniques have been developed to deal with different classes of shapes and domains, causes and sources of concentration, material behavior, phenomenological formulation, etc. These include real and complex functions, conformal mapping, transform techniques, integral equations, finite differences and relaxation, and, more recently, the finite element methods. With the advent of large high speed computers, development of finite element concepts and a good understanding of functional analysis, it is now, in principle, possible to obtain with economy satisfactory solutions to a whole range of concentration problems by intelligently combining theory and computer application. An example is the hybridization of continuum concepts with computer based finite element formulations. This new situation also makes possible a more direct approach to the problem of design which is the primary purpose of most engineering analyses. The trend would appear to be clear, i.e., the computer will shape the theory, analysis, and design. (auth)

6406 (CONF-730942–P5, pp vp Paper M 5/2) DETERMINATION OF STRESSES DUE TO DISCONTINUITIES IN FINITE PLATES OF ISOTROPIC AND ORTHOTROPIC MATERIALS. Rao, A. K. (Indian Inst. of Science, Bangalore); Dattaguru, B.; Rajaiah, K.; Venkataraman, N. S. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Stress concentrations are present in all engineering structures due to holes, cracks, sharp corners and discontinuities. They occur in reactor structural parts like core support structures and reactor vessel domes. The determination of stresses in such cases are of primary importance for assessing and ensuring satisfactory performance in respect of strength, fatigue and fracture. Certain investigations of stress concentrations (originally carried out for aerospace structures) are of relevance to reactor technology and are reported here. In these studies, a continuum approach has been followed and effective techniques have been developed for the accurate determination of stresses around circular holes and corner zones in plates made of isotropic and orthotropic materials. The solutions and method of analysis are first developed for finite isotropic plates. Plates with different hole sizes including large sized circular holes whose dimensions are comparable to the plate width are successfully dealt with. New solutions and techniques to deal with concentrations in orthotropic domains are then developed and successfully applied to circular and sharp corner discontinuities. In the first part of the paper, plates perforated with regular square and hexagonal arrays of circular holes are considered. Internal pressure and various external edge conditions are applied. Effects of hole size, geometry and loading are investigated. Effect of orthotropy is studied in the next part. Rectangular orthotropic plates with central circular holes and the axes of orthotropy inclined to the edges are analyzed. Both internal and external pressures are dealt with. Finally, stress concentrations in corner zones of orthotropic plates are investigated for certain classes of edge conditions. In all the three studies, stress functions are set up in polar trigonometric series. The conditions on the circular hole are satisfied exactly for isotropic plates and approximately by collocation for orthotropic plates. In either case, conditions on the straight edges are satisfied by suitable approximate techniques. Rapidly converging results are obtained for all the cases analysed and for hole sizes as large as 0.9 time the plate width. The accuracy of solution depends on stage of approximation, hole size, load system, symmetries in the field and the degree and orientation of orthotropy. The stress concentration factors in case of alternating external stress are much higher than those due to applied uniform loading. The physical reason is that in the cyclic stress case, each segment acts like a beam whereas in the uniform case, each segment acts like an arch. Effects of the degree and orientation of the orthotropy on the stress concentration factors for a few typical hole sizes and for typical angular corners in wedges are investigated. The results show that reductions in stress concentration factors can be achieved by a suitable choice of orthotropy. (auth)

6407 (CONF-730942–P5, pp vp Paper M 5/3) THEORY FOR CIRCULAR PLATES USING HIGHER ORDER APPROXIMATIONS. Sundara, K. T.; Iyengar, R.; Chandrashekhara, K.; Sebastian, V. K. (Indian Inst. of Science, Bangalore). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A higher order theory for thick axi-symmetric circular plates which is an extension of Reissner's shear deformation theory is presented using a variational approach. This consists in assuming a stress and displacement field which satisfies the physical requirements of the problem as nearly as possible. Thus starting with an assumed displacement field in the form of a higher order truncated polynomial in the thickness co-ordinate, (the coefficients being arbitrary functions of the other variables), and a consistent stress state satisfying the boundary conditions on the top and bottom faces of the plate, the governing equations and the associated boundary conditions along the edges are obtained through the variational theorem of Reissner. The resulting equations are such that the symmetric and anti-symmetric parts can be treated separately. Such a procedure of taking higher order truncated polynomials for displacement and stress states does not seem to have appeared in the literature on thick plates. By

suitably combining and manipulating these equations, governing equations in higher order shear stress coefficients are obtained for both symmetric and anti-symmetric problems. Once these equations are solved the solution is complete as all other unknowns can be written in terms of these shear stress coefficients. The method is applied to uniformly loaded solid and annular circular plates. To get an idea of the accuracy of the method numerical results obtained by this method are compared with those from an elasticity solution for plates under self-equilibrating normal loads. Comparisons have shown that the present method gives reasonably good agreement with elasticity solution even for a thick plate with diameter-to-thickness ratio of 2. Detailed numerical results are obtained and compared with classical and Reissner theories for uniformly loaded circular plates for various diameter to thickness ratios and for three different Poisson's ratios (viz. $\nu = 0.3$, 0.2 and 0.1). Both simply supported and clamped edge conditions are considered. Numerical results are also included for annular plates for various ratios of outer to inner diameter of the plate for a given thickness to outer diameter ratio. (auth)

6408 (CONF-730942-P5, pp vp Paper M 5/5) APPLICATION OF SIMPLIFIED HYBRID DISPLACEMENT METHOD TO PLATE AND SHELL PROBLEMS. Kikuchi, F.; Ando, Y. (Tokyo Univ.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Finite element analyses of plates and shells are of great practical significance in various branches of engineering, but the compatible displacement method is not necessarily well suited for this purpose because of complexity of available conforming shape functions. To overcome the shortcomings, a simplified hybrid displacement method is proposed and is applied to various problems of plates and shells. Furthermore, some theoretical studies have been also performed based on modern numerical analysis. Thus, the method has turned out to be effective to practical purposes due to its simplicity in computational processes and error estimations. The formulation and some applications of this approach to more complicated problems of plates and shells are summarized. First, the formulation for general shells in curvilinear coordinates is presented, and then the method is applied to the following sample problems: (1) linear analysis of shells, which includes problems for both shallow and deep shells under static loading, (2) nonlinear analysis of plates and shells with both material and geometrical nonlinearities included, and (3) dynamic analysis of shells. Of course, vibration and buckling analysis of plates and shells may be conducted with ease by using eigenvalue techniques as special cases of the above items. First, shallow shells of elliptic or hyperbolic paraboloid, or of circular cylinder shape are analyzed with the results compared with the double Fourier series solutions. A problem of unsupported deep cylindrical shell under a pair of pinching loads is also analyzed. Then nonlinear analysis is performed with respect to plates and shallow shells. Special emphasis is put on snap-through buckling of shallow shells under uniform external pressure. The general path of nonlinear equilibrium is usually followed by the piecewise linear procedure combined with the present hybrid approach, while the critical point of bifurcation is predicted by piecewise eigenvalue techniques. The dynamic analysis of snap-through phenomena is also discussed with inertia and damping forces included and a special type of lumped basis employed. In this way, the effectiveness of the simplified hybrid displacement method is investigated by numerical examples including not only linear but also nonlinear and dynamic problems of plates and shells. As a result, it turns out that this method is almost as simple as the compatible method in formulation and much more convenient in practical applications. (auth)

6409 (CONF-730942-P5, pp vp Paper M 5/6) COMPARISON OF THE NUMERICAL INTEGRATION TECHNIQUE AND THE FINITE ELEMENT METHOD IN THE ANALYSIS OF THIN-SHELL STRUCTURES. Lestingi, J. (Univ. of Akron, OH); Brown, S. Jr. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The multisegment numerical integration technique and the finite element method are compared for a variety of shell of revolution problems. The advantages and disadvantages of the finite difference, finite element, and multisegment numerical integration method are discussed. A brief description of the numerical integration technique and its relationship to the direct stiffness procedures is given. It is shown that this combination yields a powerful analytical tool for a wide range of shell of revolution problems. A numerical study on the effect of segmentation, shell thickness, and Fourier load harmonic on the manipulation error shows that (1) more segments are required for thinner shells; (2) higher harmonics require a greater number of segments; (3) results for calculations on the CDC 6600 are superior to those on the IBM 370/155; and (4) in most analyses the number of segments required for an accurate solution need not be large. Analytical and experimental results for a 3-in., 1 ply type 321 stainless steel formed bellows show that the numerical integration procedure when combined with a precise mathematical modeling procedure yields highly accurate results. A comparison between the numerical integration technique and the finite element method for a variable thickness seal subjected to an axisymmetric loading indicates that both analyses produce the same results provided that the analysis is being conducted in accordance with the ASME code requirements where primary and secondary stresses are required and peak stresses need not be calculated. A hemispherical head with a nozzle subjected to a moment was analyzed by both numerical integration and the finite element method. Both results compare well with existing theoretical and experimental data. The last example consists of a relatively thick flange subjected to a moment. The response of both models compare favorably and the linearized finite element results are identical to those of the numerical integration method. Through a series of examples, it is shown that the numerical integration technique handles a broad range of shell configurations and loading conditions. It is found that even for complex seals where it is sufficient to only define the linear stress values for the ASME code requirements, the numerical integration technique provides economical model construction and execution time. It is also shown that in many applications, mesh generation requirements of the finite element method generally exceed those of the numerical integration technique. (auth)

6410 (CONF-730942-P5, pp vp Paper M 5/8) CHARACTERISTIC PARAMETERS OF RESPONSE OF PLATES IN CONTACT. Pindera, J. T.; Sze, Y. (Univ. of Waterloo, Ont.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Problems involving the contact of flat surfaces occur frequently in engineering practice. Typical examples are flanged connections of pipes, foundations, layered soil, etc. Available methods of solutions generally neglect, usually without justification, the complicated character of stress and displacement fields occurring in structures near the contact region. Components in contact can be often approximated by thick plates of corresponding shape. However the knowledge of the real stress and deformation states in real thick plates in contact is still very limited. Results of an experimental study of the response of circular plates of various thicknesses to symmetrical punch loads are presented. The purpose of the study was to investigate the actual response of circular plates in contact to loads, to establish functional relations between the load, the geometric and material parameters of plates in contact and the geometric parameters of response, as contact area and axial deformation, etc. The more general objective was to determine which parameters are significant and which might be neglected in the development of theories for flat contact problems. The following parameters of response were considered of major interest from both theoretical and engineering points of view: the contact area, the contact stress distribution, the deformation of face surfaces, the deformation of end surfaces, and the change of overall dimensions. Results show that the diameter of contact boundary is a nonlinear function of loads when loads are below a certain value. Above this value the contact area remains practically constant in the load range higher than the nonlinear range. In this range the contact area depends essentially on the ratio (plate thickness)/(punch size), and does not depend on the plate diameter if the plate diameter is above a certain value which depends on the plate thickness and the punch size. The contact area depends on Poisson's ratio but not on Young's modulus of the contacting bodies if they are made of the same material. Some parameters of the deformation of the contacting bodies are proportional to the applied load. Functional relations between the load, the major geometric and material parameters and the major parameters of response have been established. These relations present a picture of physical phenomenon under observation given in a simple form, which seems to be sufficiently comprehensive for design purposes and for development of mathematical models serving as basis for new analytical solutions. (auth)

6411 (CONF-730942-P5, pp vp Paper M 5/9) DYNAMICAL NONLINEAR THEORY OF LAMINATED COMPOSITES. Doekmeci, M. C. (Cornell Univ., Ithaca, NY). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Whenever the dynamic problems in laminated composite struc-

tures are considered, the classical effective modulus theory of composites. which entails, for instance, no dispersion of free harmonic waves, evidently becomes inadequate. It is, therefore, imperative to use a suitable theory, that is, the recently developed effective stiffness theory, which can be applied to the dynamic problems as well. The effective stiffness theories to describe the motions of fibrous and laminated composite beams and plates have been developed but not those composite shells, to which the present paper is addressed. A composite shell consisting of N reinforcing and matrix layers, with no singularities of any kind is treated in the analysis. Each of the layers may possess different uniform thickness, orientation, and/or anisotropic properties. The deformations of the n-th layer are represented by $\{\bar{u}_i(\theta^k, t) = v_i(\theta^\alpha, t) + \theta^3 w_i(\theta^\alpha, t)\}^{(n)}$. Here, t denotes time, $\theta^k (k = \alpha, 3; \alpha = 1,2)$ a system of geodesic normal coordinates, θ^3 the thickness coordinate, $\bar{u}_i$ the shifted components of displacement vector of a generic point, v_i and w_i are unknown a priori and independent functions of class C^2. The displacement field automatically abrogates the usual Kirchhoff-Love hypothesis of shells, and it includes the effects of transverse normal strains and shear deformations as well as the rotatory inertia in all layers. In what follows, with the help of the above equation and Hamilton's principle, the approximate two-dimensional macroscopic equations which govern the motions of laminated composite shells are extracted in a straightforward and consistent manner from the three-dimensional field equations of thermoelasticity. The dynamic interactions between layers are taken into account through the displacement and traction continuity conditions at the bonding interfaces. These equations are then supplemented with the appropriate constitutive relations for the elastic layer materials, and the initial conditions. Thus, a physically and geometrically non-linear theory of laminated composite shells is constructed. Next, special cases of interest are indicated, and, in particular, the linearized version of the governing equations is given. Then, by means of Neumann's procedure, theorems of uniqueness in this theory are obtained, and the sufficient conditions to ensure the uniqueness of solutions are enumerated. Lastly, a direct method of solution (Kantorovich's method) for an alternative stress and strain analysis in laminated shells is presented in the same spirit as before. (auth)

6412 (CONF-730942-P5, pp vp Paper M 6/1) DESIGN RELATIONSHIPS AND FAILURE THEORIES IN PROBABILISTIC FORM. Smith, C. O. (Univ. of Detroit). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The engineering profession has become increasingly concerned with the adequacy of design calculations. This concern indicates a need for critical evaluation of designs based on arbitrary multipliers, such as safety factors or worst-case treatment. Design has customarily been based on applied loading, geometry, and handbook property values to give a deterministic solution. This paper presents (1) the Soderberg, Goodman, Gerber, and elliptical design relationships, and (2) the maximum shear and distortion energy failure theories in probabilistic form. Inherent in these equations are the facts that (1) design variables are generally characterized by spectra of values, rather than unique, and (2) a small, but finite, probability of failure must be recognized in any design. By coupling the mean static and mean alternating stresses (and their standard deviations) with the strengths available in a material (and their standard deviations) in one of the four design relationships using an appropriate theory of failure, the reliability of a given design can be calculated. Conversely for a given reliability, the appropriate size can be determined. Illustrations are provided. The influence of range (different standard deviations) of variables on reliability is demonstrated. A comparison is made between safety factor and reliability. (auth)

6413 (CONF-730942-P5, pp vp Paper M 7/8) LIMIT AND SHAKEDOWN ANALYSIS OF STRUCTURES WITH STOCHASTIC STRENGTHS. Augusti, G. (Univ., Florence); Baratta, A. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In recent papers the writers have presented, together with full proofs of the relevant theorems, a simple procedure for bounding on both sides the conditional probability of (plastic) collapse of any structure with stochastic "local" strengths, subjected to one- and multi-parameter "static" loads: the bounds could be made closer by successive approximations. The probability of collapse (and of survival) under loads of given distributions could also be bounded. In this paper, the theorems and procedure are further extended to cover the case of repeated and/or alternate loads, possibly including thermal and dynamic effects. Special consideration is paid to the possibility of "incremental collapse" under variable repeated loads, which is a well-known phenomenon in "classical" limit analysis. To this aim, the probabilities can be calculated of finding, among a number of displacement and stress fields, a kinematically sufficient and a statically admissible field, respectively, under loads of given maximum values that can combine and alternate in arbitrary cycles on the structure: because of theorems analogous to those presented by G. Augusti and A. Baratta, these probabilities bound the probability that the structure "shakes down" (i.e., stabilizes) under infinite cycles of the set loads, provided that the (stochastic) yield limits remain constant throughout the loading history. The same type of procedure applies when dynamic forces cannot be neglected, as shown by appropriate extension of the theorem formulated by G. Ceradini. Numerical examples illustrate the described procedures. It is finally shown that, when also the randomness of loads and load cycles must be taken into consideration, in both cases of stochastic and deterministic strengths, the more significant results are obtained via the "static" procedure, i.e., through consideration of statically admissible stress fields rather than kinematically sufficient displacement fields. (auth)

6414 (CONF-730942-P5, pp vp Paper M 7/10) PROBABILISTIC BUCKLING BEHAVIOR OF STRUCTURES WITH RANDOM LACK-OF-FIT AND GEOMETRIC IMPERFECTIONS. Mak, C. K.; Kelsey, S. (Univ. of Notre Dame, IN). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Structures in service differ from the idealized perfect structure conceived and designed by an engineer. Inevitably the difference is caused by the presence of numerous defects, deviations and geometric lack-of-fit of component members in the actual structures. To serve its intended purpose in spite of the imperfections, a real structure must function in a manner reasonably close to the idealized structures envisaged by the engineer. Otherwise the effects of the actual structural imperfections must be properly considered in the design analyses. For statically indeterminate structures, the presence of geometric lack-of-fit of the component members induces additional initial stresses to the nominal stresses caused by the applied and thermal load. It is well known that for structures which are sensitive to bifurcational buckling, the presence of initial stresses due to ill-fit reduces the buckling load capacity of the structure. On the other hand, geometric ill-fit of members occurs at random in magnitude and in spatial distribution. Therefore, to consider realistically the stability of structures with random initial stresses caused by lack-of-fit, the problem must be treated from a probabilistic point of view. In this study the buckling behavior of a structure with random lack-of-fit of members and geometric imperfections is represented by an appropriate finite element model. The probabilistic buckling behavior of the structure can be determined from the solution of the associating random eigenvalue problem. Generally, the probability distribution of the buckling load of such a structure cannot be determined exactly. In practice, however, the lower order statistical moments of the distribution can be determined approximately. Four different approximate methods of finding the expectation and the variance of the random buckling load of a structure are presented. These methods are the so called perturbation method, hierarchy method, the Taylor series method and the Monte Carlo simulation. The theoretical bases of these methods are developed, and their efficiency and degree of accuracy are examined. Numerical results are presented for a number of simple structures for which exact solutions are available for comparison. (auth)

6415 (CONF-730942-P6B-S, pp vp Paper L 2/8) THERMODYNAMICS OF SANDWICH STRUCTURES. Doekmeci, M. C. (Cornell Univ., Ithaca, NY). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

With the advances in aerospace technology, sandwich structures with high strength-to-weight capability have become an extremely desirable design feature, and owing to this, they have been extensively studied in the literature. The classical Kirchoff-Love model of shells is generally adopted in the earlier studies on this type of shells (plates). The model ignores the skin effects and the cross-sectional distortion, and thereof the coupling of adherent layers. Thus, it is evidently unable to describe the mechanical behavior of sandwich shells. Further, these studies have been based on an uncoupled analysis thereby eliminating the need for thermodynamics. Such an analysis requires that the governing equations of isothermal sandwich shells be supplemented by the temperature distribution and the appropriate constitutive relations. Also, it is noteworthy that a general coupled analysis has been left untreated even for non-isothermal shells, although its equivalent in continuum theory is available. This paper presents a general formulation for sandwich shells (plates) within the frame of the three-dimensional theory of linear, non-isothermal, an-

isotropic, coupled viscoelastodynamics. The sandwich shell treated is composed of a single-core matrix having two face reinforcement fibers. Each constituent of the shell is of different thickness and is made of dissimilar anisotropic material. Starting with the Laplace transformed local equations and using an averaging procedure, the macroscopic equations of motion of sandwich shells together with the initial and boundary conditions for the case when the displacement components of each constituent vary linearly across its thickness are established. The linearized displacement field which is unknown a priori satisfies the continuity conditions at the interfaces of constituents, and also it allows to include the effects of transverse shear and normal strains, and the rotatory inertia in the matrix and fibers. Next, by applying the averaging procedure, the generalized Gibbs relation and the balance of thermal energy are constructed, revealing the explicit form of the thermomechanical coupling terms. Interpretation for shells is then done. The temperature distribution is then obtained as well as the constitutive relations. Dynamic interactions are taken into account through the usual continuity conditions at the interfaces. Furthermore, we study the special cases of constituents made of either isotropic thermoviscoelastic or anisotropic thermoelastic materials. Lastly, a simple elastic and viscoelastic example is given in order to illustrate the relative importance of the thermomechanical coupling and inertia as compared to the quasistatic uncoupled elastic solution. (auth)

6416 (CONF-730942-P6B-S, pp vp Paper L 4/4) COMPUTATIONAL PROCEDURES FOR INELASTIC STRESS ANALYSIS. Powell, G. H.; Chi, H. M. (Univ. of California, Berkeley). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The principles and procedures used in inelastic finite element analysis are reviewed. The procedures considered include step by step analysis, constant stiffness iteration and Newton-Raphson iteration. It is emphasized that all procedures involve the sequential solution of only two subproblems, namely linearization (computation of the structure tangent stiffness) and state determination (computation of the new state of stress and strain for given displacement increments). The linearization problem is well known and is reviewed only briefly. However, the state determination problem is at least as important yet has been examined much less thoroughly in the literature. The state determination computations are described, and the importance of path dependence is emphasized. A general solution strategy is proposed, in which the analyst can select essentially any combination of step by step and iterative solution procedures by specifying the values of three convergence tolerances. Added sophistication, with relatively little increase in complexity, can be obtained by allowing the analyst to specify when unloading is expected to occur and when new linearization is to be suppressed. Over-relaxation procedures to speed the convergence of constant stiffness iteration are briefly reviewed. Within the general solution strategy, thirteen different procedures can be obtained by varying the convergence tolerance values. A simple example (tension strip with central hole) is used to compare the computational effort required for each of the procedures. The computed peak strain values and the numbers of linearization and state determination computations required for each procedure are tabulated, and the computational effort is shown to vary widely. The results indicate that iteration procedures of Newton-Raphson type are likely to be more efficient than those of constant stiffness type without over-relaxation. (auth)

6417 (CONF-730942-P6B-S, pp vp Paper L 4/9) DYNAMIC PLASTICITY. Lee, L. H. N. (Univ. of Notre Dame, IN). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Dynamic plasticity is concerned with the studies of motion and deformation of various deformable solids under high rate of loading which strain the solids beyond their elastic limits. In recent years, the field has seen an increased development influenced by the needs of solving practical problems such as high-velocity forming of metals, resistance of structures to collisions, blast loadings or destructive earthquakes and responses of structures or machines to dynamic loads. A number of survey papers are available in the literature. This paper is to supplement them by emphasizing some aspects of the recent developments in the last five years and not to give an over-all review of dynamic plasticity. Advances have been recently made in the following areas of dynamic plasticity: (a) changes of microstructures of metals, (b) continuum constitutive relationships, (c) coupling of plastic waves, (d) wave propagations involving finite strains, and (e) dynamic behavior of inelastic structures at finite deformation. The movement of dislocations and the development of twinning in metal crystals caused by impacts have been studied. Progress has been made on time dependent multiaxial stress-strain relationships by relating conceptually the macroscopic inelastic strains and microstructural slip displacements as modeled either by continuum shearing on crystallographic planes of individual grains or by the motion of discrete dislocation lines. However, experimental evaluation of time dependent multiaxial stress-strain relationships is lacking and hindered by analytical and experimental difficulties. Despite the difficulties in the area of constitutive relationships, substantial progress has been made in the other areas. Interactions between loading and unloading waves caused by combined stresses have been studied principally by the method of characteristics. Most of the analyses are restricted to that of one spatial independent variable and infinitesimal strains. Problems on finite strain and shock waves have also been investigated. Various variational methods, energy methods and finite-differences and finite element numerical methods have been developed to study the dynamic responses of beams, plates and shells at finite deformation. The progress made in these areas provides additional physical insight in treating practical problems. (200 references) (auth)

6418 (CONF-730942-P6B-S, pp vp Paper L 7/6) BOUNDARY-VALUE PROBLEMS IN CYCLIC PLASTICITY. Mroz, Z. (Inst. of Fundamental Technical Research, Warsaw). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In order to predict the critical number of cycles before rupture, the stress distribution within the structure should be known under cyclic loading. Generally, a steady cyclic state occurs before onset of failure. For moderate temperatures, the viscous effects can be neglected and only instantaneous plastic deformations need to be considered. To describe analytically a steady cyclic state for moderate temperatures, a simplified approach has been used. It is assumed that the material possesses a discrete memory of past loading history and only maximal values of stresses from the past affect the actual behavior which is piecewise analytical. Principal shear stress rate reversals define consecutive portions of stress paths along which finite stress-strain relations are valid. Particular constitutive relations are discussed which are based on the concept of field of hardening moduli (see: Z. Mróz, On the Description of Anisotropic Workhardening, J. Mech. Phys. Sol., vol. 15, 1967). Several boundary-value problems are treated for disks, tubes and circular plates subjected to cyclic loading. For non-linear homogeneous stress-strain relations, the dissipation per cycle can be simply calculated and stress distribution during proportional cyclic loading can be obtained by proper scale mapping of the solution for monotonic loading. For high temperatures, the viscous strain components should be accounted for. The total strain is assumed to be composed of elastic, thermal, instantaneous plastic, and viscous terms. The viscous strain rates are determined using a creep hardening law and accounting for the anisotropy of viscous hardening. The initial transient cyclic state is most difficult to analyze and rate constitutive relations should be used with additional state variables defining the state of hardening. The cyclic solution can be determined by step-by-step integration of constitutive rate equations. (auth)

6419 (LA-5573-MS) DEVELOPMENT OF A MOBILE ROCK-MELTING SUBTERRENE FIELD UNIT FOR UNIVERSAL EXTRUDING PENETRATORS. Griggs, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

A mobile rock-melting unit has been developed for field demonstration and testing of universal extruding penetrators. The design, features, component functions, and operating data for this unit are described. (auth)

6420 (LA-UR-74-328) VISCOUS MELT FLOW AND THERMAL ENERGY TRANSFER FOR A ROCK-MELTING PENETRATOR: LITHOTHERMODYNAMICS. McFarland, R. D.; Hanold, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 17p. (CONF-740613-1). Dep. NTIS $4.00.

From Heat Transfer and Fluid Mechanics Institute conference; Corvallis, Oregon, USA (12 Jun 1974).

The objective of the Subterrene program is to develop new, innovative systems for drilling and excavation based on the rock-melting concept. The development of rock-melting penetrators has advanced to the stage that it is necessary to be able to predict the relationships between applied thrust, power, surface temperature, and penetration rate for a wide variety of penetrator geometries and rock-soil mediums. These predictions are required to assess the practical limits of operation of various penetrators in different rocks and to aid in determining optimum penetrator shapes for specific excavation applications. The methods described herein represent a significant step to satisfy these analytical requirements. The basic operation of a melting penetrator in porous rock where the molten debris from the hole is

disposed of by density consolidation is treated. Using a simplistic conduction analysis, optimum penetrator geometries are derived for the restricted case where local density consolidation prevails. The general problem is then formulated in terms of the two-dimensional Navier Stokes equations, energy equation, and the continuity equation with temperature dependent properties. These equations are cast in a general curvilinear, orthogonal coordinate system which corresponds to the typical melting penetrator shape. These equations are solved numerically and calculated results for required heated surface power, required thrust load, and the melt layer thickness distribution for a given penetration rate and surface temperature are presented for some typical penetrator geometries. (auth)

6421 (RDT-M-1-21-T(4-74)) CONSUMABLE WELDING INSERTS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Apr 1974. 10p. RSO.

This standard covers the manufacture of consumable welding inserts without restriction of size, shape, or form. (TFD)

6422 (SLA-74-5032) VACUUM-ULTRA-VIOLET XENON LASER. Johnson, A. W.; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 4p. (CONF-740617-1). Dep. NTIS $4.00.

From 8th international quantum electronics conference; San Francisco, California, USA (10 Jun 1974).

The addition of helium as a diluent to xenon improves the performance of the vacuum-ultraviolet (vuv) xenon laser. A numerical model and the experimental results demonstrate that the 1720 Å xenon laser can be efficiently utilized. (auth)

6423 (TID-26567) HANFORD PLANT STANDARDS: ELECTRICAL STANDARDS. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). [nd]. 304p. Dep. NTIS $18.25.

Codes and standards for electrical systems at the Hanford Plant are presented. (TFD)

6424 (TID-26568) HANFORD PLANT STANDARDS: GUIDES. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). [nd]. 451p. Dep. NTIS $25.75.

Codes and standards for piping used at the Hanford Plant are presented. (TFD)

6425 (TID-26569) HANFORD PLANT STANDARDS: ARCHITECTURAL AND CIVIL STANDARDS. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). [nd]. 312p. Dep. NTIS $18.75.

Codes and standards for structures at the Hanford Plant are presented. (TFD)

6426 (TID-26576) HANFORD MECHANICAL STANDARDS. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 1973. 265p. Dep. NTIS $16.25.

Codes and standards for mechanical equipment at the Hanford Plant are presented. (RCK)

6427 SINGLE MODE LASER OSCILLATOR WITH LINEAR RESONATOR AND INTERNAL FARADAY ISOLATOR. Heflinger, L. O.; Wuerker, R. F. (to TRW Inc.). US Patent 3,801,931. 2 Apr 1974. Filed date 30 Nov 1972. 8p.

A standing lightwave within the active lasing medium of a laser oscillator is avoided to prevent periodic bleaching of the medium and thereby foster single mode oscillation and improve coherence. A Faraday isolator and an optical rotator located within the opposite end regions of the laser resonator cavity, between the lasing medium and cavity end reflectors, changes the direction of polarization of the coherent light propagating through these cavity regions and blocks oscillation of light which propagates from the lasing medium with other than certain favored directions of polarization in such a way that the oppositely traveling lightwaves within the lasing medium have mutually perpendicular planes of vibration and hence do not interfere to produce a standing wave in the medium. The oppositely traveling lightwaves within one end of the resonator cavity establish a standing wave region in which may be located a bleachable mode selector, such as a dye cell, for suppressing undesired oscillating modes and thereby further improving coherence. (Official Gazette)

6428 APPLICATION OF RARE EARTHS IN OPTICAL MATERIALS AND DEVICES. Yocom, P. N. (RCA/David Sarnoff Research Center, Princeton, NJ). pp 229-239 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From analysis and application of rare earth materials conference; Kjeller, Norway (23 Aug 1972). See CONF-720839-.

Optical materials and devices which contain rare-earth elements can be divided into the divisions of light emitting and light modifying. In the light-emitting category a subdivision of incoherent and coherent materials and devices is made. The incoherent area comprises materials used in cathode ray tubes, fluorescent lamp devices, electroluminescent devices, thermoluminescent dosimeters, and upconverting phosphors or quantum counters. The coherent devices are a large number of optically pumped lasers of which the most useful are the neodymium-activated materials such as yttrium aluminum garnet and glasses. Some of the experimental laser types are mentioned as possible future directions in which rare earth containing lasers may go. In the area of light-modifying materials and devices the first subject treated in the materials which show photochromic behavior or reversible coloration under suitable light sources. The other areas mentioned are electro-optic materials and devices covering the ferroelectrics and finally mentioning magneto-optic materials and some devices associated with the effect. (auth)

6429 SAMPLING SYSTEM FOR ATMOSPHERIC HT AND HTO. Oestlund, H. G. (Univ. of Miami, FL). Contract AT-(40-1)-3944. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 510-512(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A system is briefly described, which is designed for the sampling of tritium gas (HT and T_2) and tritiated water vapor in the air at levels far below MPC and down to present-day atmospheric background levels. The tritium gas is extracted from the air by catalytic combustion on Pd at ambient temperature. The resultant water is absorbed on a molecular sieve carrying the Pd. The system is well suited for field work. Present-day worldwide HT levels are about 2.3 pCi/kg air, and the HTO levels about the same in the troposphere. (auth)

6430 NUCLEAR PUMPING OF LASERS. Russell, G. R. (California Inst. of Tech., Pasadena). pp 31-38 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From second symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The results of present experiments on nuclear pumping are summarized. Several laser gases were studied. Efficiency data are given for neutron and gamma ray excitation and for various discharge currents. The effect on CO_2 lasers is discussed in particular. (MOW)

6431 NUCLEAR RADIATION ENHANCEMENT OF CO_2 LASER PERFORMANCE. Ganley, T.; Verdeyen, J. T.; Miley, G. H. (Univ. of Illinois, Urbana). pp 39-44 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From second symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The effect of nuclear radiation on the operation of electrically excited CO_2 lasers is discussed. Three types of experiments and results are presented: (1) low-pressure cw laser; (2) low-pressure pulsed laser; and (3) high-pressure TEA pulsed laser. (auth)

6432 CO_2 LASER EXPERIMENTS USING NUCLEAR REACTIONS AS THE IONIZATION SOURCE. Rhoads, H. S. (Univ. of Florida, Gainesville); Schneider, R. T. pp 53-57 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From second symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Experimental studies show that the output of a CO_2 laser is significantly increased by products of the nuclear reaction ^3He (n,p)T. Helium-3 was used in lieu of the natural helium normally present in the 1:1:8 $CO_2:N_2:He$ laser gas mixture (pressure = 6 torr). The laser assembly was then exposed to a reactor thermal neutron flux of about 10^8 neutrons cm^{-2} sec^{-1}. Power output of the laser doubled while the electrical power input decreased; electrical efficiency was thus more than doubled. Results indicate that additional ionization by the energetic charged particles may be responsible for the improved laser performance. (auth)

6433 GAS LASER APPARATUS HAVING LOW TEMPERATURE SENSITIVITY. Kawasaki, H. (to Asahi Kogaku Kogyo Kabushiki Kaisha). US Patent 3,801,929. 2 Apr 1974. Filed date 31 Jul 1972. 8p.

A gas laser including a cylindrical-shaped enclosure housing that is made of a low thermal expansion coefficient material is described. A laser discharge tube has positive and negative spaced

electrodes at opposite ends. A pair of resonator mirrors are positioned one at either end of the laser discharge tube in the path of a laser beam passing out of the discharge tube. A piezoelectric device is operably connected to one of the mirrors for adjusting the position of such mirror relative to the other mirror. The resonator mirrors, the crystal, and the laser discharge tube are mounted substantially symmetrically about the central axis of the cylindrical-shaped enclosure housing. (Official Gazette)

6434 SINGLE MODE LASER OSCILLATOR WITH RING RESONATOR AND INTERNAL FARADAY ISOLATOR. Wuerker, R. F.; Heflinger, L. O. (to TRW Inc.). US Patent 3,801,930. 2 Apr 1974. Filed date 30 Nov 1972. 8p.

A standing light wave within the active lasing medium of a laser oscillator is avoided to prevent periodic bleaching of the medium and thereby foster single mode oscillation and improve coherence. The laser oscillator includes a ring resonator having a 180° optically folded portion and a ring portion containing the lasing medium and an optical rotator. The Faraday isolator and optical rotator permit coherent light propagation in one direction only through the resonator cavity, such that light reflection occurs in one direction only through the lasing medium and no standing wave is created in the medium. The oppositely traveling light waves within the folded cavity portion establish a standing wave region in which may be located a bleachable mode selector, such as a dye cell, for suppressing undesired oscillating modes and thereby further improving coherence. (Official Gazette)

6435 HIGH-ENERGY AMPLIFIERS FOR THE LASL GLASS-LASER SYSTEM. Mace, P. N.; Tanner, R. L. (Los Alamos Scientific Lab., NM). IEEE (Inst. Elec. Electron. Eng.), J. Quant. Electron.; QE-10: No. 2, 267-272(Feb 1974). (LA-UR-73-812).

Rod amplifiers of 51-mm diameter and disk amplifiers with diameters of 51 and 86 mm were designed and some units have been built for use in a four-beam high-energy glass laser at the Los Alamos Scientific Laboratory (LASL). The design goals and measured characteristics of these amplifiers are discussed. Data on self-focusing damage in both rods and disks are presented. Important characteristics of capacitor-bank design, flashlamp construction, and laser glass are discussed. Completion of the four-beam system is scheduled for early 1974. (auth)

6436 DAMAGE RESISTANT TUNABLE CW DYELASER. Lempicki, A.; Jacobs, R. R.; Samelson, H. (to GTE Laboratories Inc.). US Patent 3,805,187. 16 Apr 1974. Filed date 17 Nov 1972. 10p.

A damage resistant tunable continuous wave (cw) dye laser is described that consists of a hydro-dynamically contoured interaction region, with a thick input window which is coated to be optically inert to the pumping laser, and a thick output window which is contoured as a lens to emit parallel rays of laser energy. The dye laser is so constructed as to be pumped by a cw laser source whose energy is concentrated in a small area or spot. The intense energy produced by narrowing the pumping laser to a spot produces damaging effects on materials close to the focal point of the pumping laser. Such damaging effects are reduced by removing the damagable materials such as anti-reflective (ar) coatings or mirror systems away from the focal point of the pumping laser because the energy of the laser is spread over a larger area. When the laser energy is distributed over a larger area the energy per square surface area is thereby reduced to a tolerable amount. The pumping laser is focused to a narrow spot within the interaction region of a turbulently flowing liquid dye material, thereby producing a population inversion within the dye material which in turn creates laser action. (Official Gazette)

6437 LASER AND METHOD OF OPERATION. Allen, R. A. (to Avco Corp.). US Patent 3,801,927. 2 Apr 1974. Filed date 24 May 1967. 6p.

A laser and its operation are described wherein an optical resonator which receives a gas from a supersonic nozzle includes a fully reflective mirror and an oppositely disposed mirror partially transmissive by reason of hole coupling. The partially transmissive mirror does not include a permanently mounted transmitting window during operation. During startup, the holes are covered by a shutter or the like and after the laser has been started aerodynamically, the holes are uncovered. (Official Gazette).

6438 UNITARY GLASS LASER ASSEMBLY. Woodcock, R. F. (to American Optical Corp.). US Patent 3,805,186. 16 Apr 1974. Filed date 29 Nov 1972. 6p.

A unitary laser rod configuration provides improved optical coupling between the flashlamps and the activated laser rod where the active substance in the laser rod is trivalent erbium ions. The components are arranged in a "double-U" laser configuration wherein the centrally located laser rod is surrounded by an annular cladding of sensitizing material. The core with its sensitizing cladding is then immersed in a clear glass outer cladding which forms the remainder of the unitary double-U configuration. This configuration provides optimal efficiency. (Official Gazette)

6439 APPARATUS FOR OPTICAL EXCITATION OF A LASER ROD. Steffen, J. (to Institut fuer Angewandite Physik der Universitaet Bern). U. S. Patent 3,803,509. 9 Apr 1974. Priority date 30 Apr 1971, Switzerland. 4p.

An apparatus is described for effective and uniform optical excitation of laser material for light amplifiers (lasers) comprising a laser rod which extends through one of the focal lines of an elliptically tubular mirror or of an ellipsoidal mirror, a flash-light lamp passing through the other focal line of the mirror, the lamp and rod extending parallel to one another. The lamp and the laser rod are each surrounded by a respective cooling tube, through which a cooling fluid flows, the cooling tube surrounding the laser rod being light-dispersive to provide substantially circular lines of equal intensity of optical excitation around the rod. (Official Gazette)

6440 ELECTRON-BEAM PUMPED LASER WITH EXTENDED LIFE. Nicoll, F. H. (to RCA Corp.). U. S. Patent 3,803,510. 9 Apr 1974. Filed date 27 Sep 1972. 6p.

An electron-beam pumped semiconductor laser with an extended life is provided by scanning the electron beam over a relatively large portion of the surface of the laser element and thereby preventing a localized burn-out of the laser element. (Official Gazette)

6441 HYDROGEN–FLUORIDE CHEMICAL LASER OSCILLATOR. Pettipiece, K. J. (to United States Atomic Energy Commission). U. S. Patent 3,803,512. 9 Apr 1974. Filed date 29 Sep 1972. 4p.

A hydrogen-fluoride chemical laser oscillator capable of producing short (to less than 5 nsec) light pulses in a selected TEM mode is described. Lasing results from a reaction of flowing gaseous mixtures, such as SF_6 and CH_4, which produce hydrogen-fluoride, at pressures ranging from about 100 to 350 torr when initiated by an electrical discharge in a resonant optical cavity. (Official Gazette)

6442 SINGLE HETEROSTRUCTURE JUNCTION LASERS. Hayashi, I. (to Bell Telephone Labs., Inc.). U. S. Patent 3,801,928. 2 Apr 1974. Filed date 17 Nov 1972. 16p.

A light emitting heterostructure diode includes a multilayered structure having a common conductivity type heterojunction and a p–n junction separated therefrom by a distance less than the diffusion length of minority carriers, thereby defining an intermediate region bounded by the junctions. In a single heterostructure (SH) diode there is one such heterojunction separating narrow and wide band gap regions of the same conductivity type and the p–n junction is a p–n homojunction formed in one instance by the diffusion of impurities into the narrow band gap region. When provided with an appropriate resonator, a confinement effect produced by an energy step (at the heterojunction) in the conduction band permits the SH diode to lase at higher temperatures and lower thresholds than heretofore possible, radiative electron-hole recombination occurring between the conduction and valence bands. In a double heterostructure (DH) the diode is provided with a second heterojunction positioned on the side of the p–n junction remote from the other heterojunction, or positioned coincident with the p–n junction, thereby defining an intermediate region between the pair of heterojunctions. When provided with an appropriate resonator the DH diode exhibits lower thresholds at higher temperatures than even the aforementioned SH diode. In both diodes additional improvement in the threshold occurs if the diode is provided with deep impurity levels or deep band tails. Without a resonator, both the SH and DH diodes function as electroluminescent diodes with radiation being emitted from the intermediate region through the wide band gap region, thereby advantageously resulting in lower absorption losses and higher efficiency. Dome-like configurations of the wide band gap region of this diode are also disclosed. (Official Gazette)

6443 USE OF β EMITTERS IN ELECTRON-IONIZATION LASERS. Takibaev, Zh. C.; Kostritsa, A. A. (Vestn. Akad. Nauk Kaz. SSR; No. 1, 56-58(1974). (In Russian).

The degree of ionization produced by electrons was calculated to determine if β emitters could be used to obtain high laser generation in electron ionization lasers. The results showed that β emitters can guarantee the ionization necessary for the operation of electron ionization laser to a large volume of the working medium at high pressure. (JSR)

6444 CONVERSION OF A URANIUM PLANT TO THE RECOVERY OF ZINC. Cross, H. E. J. S. Afr. Inst. Mining Met.; 74: No. 4, 140-148(Nov 1973).

The conversion of the Vogelstruisbult Uranium Plant into a plant for the production of electrolytic zinc is described. The reasons for the conversion, the preliminary investigations, and the basic design principles are all outlined, and a brief account is given of operating experience, during the commissioning of the plant, with equipment that had been put to a use for which it was not originally intended. (auth)

6445 FREEZING-UP SHAFT SEAL OF MACHINES FOR THE TRANSPORT OF LIQUIDS AND GASES IN NUCLEAR POWER. Matal, O. A. Czech Patent 146,660. 15 Dec 1972. 2p. (In Czech).

A freezing-up seal for machine shafts is proposed for use in machines transporting liquids and gases in nuclear power. The seal is especially suitable for the sealing of sliding bearings lubricated with a liquid metal. The seal consists of a liquid metal cooler placed inside the seal body. The cooler supports at least one spring pressing the sealing mass well against the seal body and the shaft. The liquid metal cooler prevents the liquid metal from direct contact with the coolant, and also controls the coolant flow in the helical groove to avoid non-uniform cooling of the liquid metal, thus preventing any possible leakage through the freezing-up shaft seal. The pressure spring effects a permanent compression of the sealing mass during operation. (INIS)

6446 CO_2 GAS LASER EXCITATION AND GAIN. Mills, C.B. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). J. Appl. Phys. 45: No. 3, 1336-1341 (Mar 1974).

Calculations of laser-beam amplification have been made by integration of energy-conservation equations using excitation rates and interlevel vibrational-energy-exchange rates. The vibrational-energy-level populations were used in laser gain equations. Excitation rates were determined by integration of the Boltzmann equation to obtain the electron energy distribution. The excitation cross sections were taken from Phelps's work, and the potential gradient per molecule (E/N) was determined by solution of the current continuity equation using transport constants derived by methods described by Phelps. The laser gain equations were then used to predict the optimum laser energy storage, which was about 10% of the electrical energy supplied. This is not a strong function of any single parameter except time and E/N. (auth)

6447 ROTATIONAL RELAXATION RATE CONSTANTS FOR CO_2. Jacobs, R.R.; Pettipiece, K.J.; Thomas, S.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Appl. Phys. Lett. 24: No. 8, 375-377 (15 Apr 1974).

Rotational relaxation rate constants, k_{rot}, have been measured for the CO_2 00°1 level in three kinds of amplifiers: one using CO_2 alone and two others using mixtures of CO_2–He and CO_2–N_2. The experiment consists of perturbing the CO_2 00°1 level with a ~2-nsec saturating pulse at P(20) in the 10.4-μ band and monitoring the subsequent repopulation of the J=19 rotational state with a probe beam set at P(20) in the 9.4-μ band. The determined rate constants are $k_{CO_2\text{-}CO_2}=1.3\pm0.2$, $k_{CO_2\text{-}He}=0.6\pm0.1$, and $k_{CO_2\text{-}N_2}=1.2\pm0.2$, all in units of 10^7 sec^{-1} $Torr^{-1}$. (auth)

6448 MODEL DEVICE FOR TESTS WITH BEARING MATERIALS IN LIQUID SODIUM. Matal, O.; Sobotka, J.; Wagner, S. (Prvni Brnenska Strojirna, Brno). Jad. Energ.; 20: No. 2, 42-44(1974). (In Czech).

A description of an experimental device designed for testing wear-, frictional- and adhesive properties of materials in liquid sodium is given. (auth)

6449 PULSE COMPRESSION FOR MORE EFFICIENT OPERATION OF SOLID-STATE LASER AMPLIFIER CHAINS. Fisher, R.A.; Bischel, W.K. (Department of Applied Science, Davis-Livermore, and Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Appl. Phys. Lett. 24: No. 10, 468-470 (15 May 1974).

We propose a pulse compression scheme which reduces the peak intensity while increasing the energy density achievable in a Nd:glass amplifier chain. Self-focusing is the dominant effect responsible for limiting the power of a short-pulse Nd:glass amplifier chain, and the reduction of the intensity (through this compression scheme) greatly reduces these problems. We recommend injecting a lower-intensity and longer-duration pulse into the chain. Under some circumstances, the glass nonlinearity will impress upon the pulse a chirp suitable for efficient subsequent temporal compression, and this may result in higher effective peak power operation. If a 1-nsec (full 1/e duration) temporally Gaussian pulse with a chain-averaged peak intensity of 2 GW/cm^2 propagates 2 m in a Nd:glass laser chain, we calculate that the pulse could be subsequently compressed (by a series of Gires-Tournois interferometers) to 125 psec with good stability against input pulse amplitude noise. Such short pulses are of major interest for laser fusion. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 8879–8881.

6450 NEW FIELDS OF RESEARCH IN THE PHYSICS SPECIAL APPLICATIONS LABORATORY OF THE GRENOBLE RESEARCH CENTER: CRYOGENICS. Bull. Inform. Sci. Tech. (Paris); No. 186, 77-100(Nov 1973). (In French).

The heat transfer coefficients for free and forced convection in cryogenic fluids such as nitrogen, hydrogen, deuterium, neon, and ammonia were studied. Measurements made of the heat transfer coefficient and critical heat flux (burnout) are compared with correlations established for classical fluids. The pressure drops occurring were studied. A model for a cold neutron source incorporating a liquid hydrogen vortex layer was developed for the Grenoble High Flux Reactor; the stability conditions of the cryogenic heat pipe were also studied. Investigations of the hydrogen slush led to the development of an apparatus for density determinations from β- and γ-ray attenuation measurements. The behavior of the basic components of a liquid hydrogen pump with a submerged motor was studied, i.e., endurance tests of the special bearings and measurements of the characteristics of an asynchronous electric motor under cold conditions. (FR)

6451 HEAT TRANSFER AND FRICTION COEFFICIENTS FOR TURBULENT FLOW OF AIR IN SMOOTH ANNULI AND HIGH TEMPERATURES. Dalle Donne, M.; Meerwald, E. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Heat Mass Transfer; 16: 787-809(1973). (KFK-1807).

Local heat transfer and averaged friction coefficients were measured for subsonic turbulent flow of air through two smooth annuli, with diameter ratios equal to 1:99 and 1:38, respectively, having the inner tube heated up to temperatures of 1000°C. The main experimental results can be summarized as follows: (1) the local heat transfer coefficients are correlated by: $Nu_B = 0.18(D_2/D_1)^{0.16}$ $Re_B^{0.8}Pr_B^{0.4}(T(W)/(E))^{-0.2}$ which gives the Petukhov and Roizen correlation for low temperature differences ($T(W)/T(E) \rightarrow 1$); (2) the average heat transfer coefficients for the inner region of the annulus are correlated by: $Nu_B = 0.0217\ Re_B^{0.8}Pr_B^{0.4}(T(W)/T(E))^{-0.2}$ in excellent agreement with data for circular tubes (Dalle Donne–Bowditch correlation); and (3) the friction coefficients, both for the whole annulus and the inner region of it, are in excellent agreement with the correlations of Maubach obtained by integration of the universal velocity profile of Nikuradse, provided that density of the fluid is evaluated at the temperature $T_x = \sqrt{(T(W) \times T(B))}$ and the kinematic viscosity at the temperature T(W), as suggested by the experiments of Taylor for circular tubes. (GE)

6452 SIMPLE METHOD OF PREDICTING FRICTION FACTORS OF TURBULENT FLOW IN NONCIRCULAR CHANNELS. Rehme, K. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Heat Mass Transfer; 16: 933-950(1973). (KFK-1802).

On the basis of friction factor relationships of a simple model a method is developed which allows the prediction of friction factors for turbulent flow in non-circular channels if only the geometry factor of the pressure drop relationship for laminar flow is known. The proposed method of calculation is tested with numerous experimental results from the literature with respect to noncircular channels such as triangular shaped ducts, eccentric annuli and rod bundles in hexagonal and square arrays in circular tubes, hexagonal and square channels. It turns out that the proposed method provides an excellent description of all the experimental data at hand. (GE)

6453 COMPARISON OF CALCULATED AND EXPERIMENTALLY DETERMINED VALUES OF THE CRITICAL HEAT TRANSFERRED PER UNIT SURFACE. Katsaounis, A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Brennst.-Waerme-Kraft; 25: No. 7, 267-274(1973). (In German). (GKSS-73-E-2).

The measured critical heat transferred per unit surface of nine- and four-rod bundle geometries was correlated by means of two computer programs with several relations termed W2, W3, Wilson/Ferrell and Janssen/Levy. One of the programs calculates the critical heat flux assuming a total cross mixing over all channels of the bundle, whereas the other does not allow for cross mixing in the single subchannels. All relations mentioned above, except for that by Janssen/Levy, show among other things a dependence of the quotient of the calculated and the measured critical heat

flux on the ratio between the rod subject to maximum heating and the remaining, less heated rods within the rod bundle. (GE)

6454 INFLUENCE OF TWISTED TAPES IN SUBCRITICAL, ONCE-THROUGH VAPOR GENERATORS IN COUNTER FLOW. Cumo, M.; Farello, G. E.; Ferrari, G.; Palazzi, G. (CNEN, Rome). Termotecnica (Milan); 28: No. 3, 147-156 (Mar 1974).

From national ATI annual meeting; Naples, Italy (Sep 1972).

The swirl flow of freon 12 in a tubular heat exchanger indirectly heated by forced convection water in an annular gap was studied. The flow of freon is upward, once-through. Two identical situations are compared, with and without a twisted tape, to deduce the influence of the swirl flow in the particularly interesting boundary condition of indirect heating by another fluid (and not simply of uniform Joule heating). The thermal powers exchanged are greatly increased in the swirl flow, up to a factor two at the burnout or dryout point. A comparison with the burnout powers computed for the case of uniform Joule heating and straight flow is then done, and the burnout wall temperatures are drawn versus the reduced pressure, up to the critical value. (auth)

6455 INVESTIGATING THE TRUE VOLUMETRIC STEAM CONTENTS IN A HEATED TUBE WITH RISING AND FALLING MOTION OF A TWO-PHASE FLOW. Lobachev, A. G.; Kol'chugin, B. A.; Zakharova, E. A.; Kruglikhina, G. G. Therm. Eng. (USSR) (Engl. Transl.); 20: No. 5, 105-107 (1973).

Translated from Teploenergetika; 20: No. 5, 75-77 (1973).

Experiments were performed to investigate variation in true volumetric steam contents, ϕ, in a small diameter heated tube. The investigations of ϕ were conducted in a vertical electrically heated tube 12.1 mm in dia and 2500 mm in length with rising and downcoming motion of two-phase mixture. To measure tube cross section average steam content a wide beam of γ-rays from ^{170}Tm was used. Maximum error in measuring quantity ϕ amounted to ± 0.05. The experiments were conducted at pressures p = 19.6, 68.6, and 98 bar; at circulation rates w_0 = 1.0, 2.0, and 4.0 m/s; at specific thermal loads q = 0.29, 0.58, and 1.16 MW/m^2, while relative enthalpies x were varied from −0.2 to +0.4. Experimental data were obtained under conditions of hydrodynamic and thermal stabilization of the flow. For this purpose a heated section of the tube about 100d in length preceded the lower γ-ray point in the experiments. The results of the experiments are given. The investigations showed that the direction of motion of the flow appreciably affects ϕ. At low circulation rates ($\phi_{down} > \phi_{ris}$), as the circulation rate increases the influence of the orientation of gravity force on quantity ϕ becomes less appreciable. (LCL)

6456 THERMAL STABILIZATION FOR CONVECTIVE HEAT TRANSFER IN DUCTS OF COMPLEX PROFILE. Bobkov, V.P. (Physics and Power Institute, Obninsk). High Temp. 11: No. 3, 513-516 (Jan 1974).

The stabilization of heat transfer in ducts having a complex cross section is analyzed. A simplified model is constructed to estimate the intercellular thermal stabilization length and the temperature difference between cells in the initial section. (auth)

6457 HEAT TRANSFER BY FREE CONVECTION FROM HORIZONTAL CYLINDERS TO CO_2 UNDER NEAR-CRITICAL CONDITIONS. Beschastnov, S.P.; Petrov, V.P. (Moscow Engineering-Physics Institute.). High Temp. 11: No. 3, 524-528 (Jan 1974).

Heat transfer from horizontal pipes with a diameter of 2, 3, 6, and 9 mm to CO_2 in the case of free convection is investigated. The temperature of the fluid varied from 25 to 50°C, pressure from 7.4 to 8.8 MN/m^2, and the heat flux reached 1.6×10^4 W/m^2. Visual observations and photographs are presented. A relation generalizing the experimental results is obtained. (auth)

6458 HEAT-TRANSFER REGIMES FOR MIXED CONVECTION IN VERTICAL TUBES. Kamenetskii, B. Y. (G. M. Krzhizhanovskii Energhetics Institute). High Temp. (USSR) (Engl. Transl.); 11: No. 2, 305-309 (Nov 1973).

We consider conditions under which the free convection has substantial effect on heat transfer in turbulent flow in vertical tubes of a heat carrier with variable properties. To estimate this effect, a dimensionless number is obtained whose value characterizes the laminar boundary layer under the action of lift forces. For the rising motion case, where water flows in a heated tube at supercritical pressure, a set of regimes is determined for which a decrease in the intensity of the heat transfer is observed as a result of the influence of the free convection. (auth)

6459 DETERMINATION OF THE CRITICAL VALUE OF HEAT TRANSFER IN THE PRESENCE OF LARGE VAPOR CONTENTS. Muranov, Y.V.; Klochkova, L.F. (Physicoenergetic Institute). High Temp. 11: No. 2, 310-315 (Nov 1973).

On the basis of existing concepts of the diffusion of drops in a two-phase flow, a calculation model is proposed for determining the critical loads in vertical, round tubes with uniform heating over the length in the presence of large vapor contents. (auth)

6460 EXPLANATION OF THE CAUSE OF THE MARKED DECREASE OF THE CRITICAL HEAT FLUX DURING FLOW OF A VAPOR-LIQUID MIXTURE IN TUBES. Ivashkevich, A.A. (Physicoenergetic Institute). High Temp. 11: No. 2, 316-322 (Nov 1973).

The article presents an analysis of an approximate equation of the critical value of nucleate boiling in long and short tubes. An explanation of the cause of the marked decrease of the critical heat flux is proposed. Equations are obtained for the boundary and critical vapor content, and they are compared with the experimental data of other investigations. (auth)

Materials Testing

Refer also to abstracts 6608 and 6763.

6461 (RDT-F-3-6-T(2-74)) NONDESTRUCTIVE EXAMINATION. (USAEC Division of Reactor Research and Development, Washington, D. C.). Feb 1974. 52p. RSO.

The standard includes nondestructive testing of materials, welds, and components intended for use in nuclear and associated applications. (TFD)

6462 INVESTIGATIONS ON AUTORADIOGRAPHY AND NEUTRON RADIOGRAPHY WITH COLOR FILMS. Bodemann, M. Bonn; Univ. Bonn (1971). 104p. (In German).

Thesis.

The paper deals with the recording technique of color-autoradiographic images and with the photographic films used for this purpose. For ^{63}Ni as a radiation source and three-sheet color films as a detector, the spatial resolution was determined experimentally and theoretically. The results are compared with familiar methods of black and white radiography. (GE)

6463 SURVEY OF DEFECTOSCOPIC METHODS. Balmler, M. (Stredni Prumyslova Skola Jaderne Techniky, Prague). Jemna Mech. Opt.; 18: 307-312 (Nov 1973).

A brief review of the principles of the most widely used methods for nondestructive testing of materials is presented. The methods discussed include the magnetic flow method, the use of x and gamma radiation, ultrasonic testing, capillary methods, electromagnetic methods, the use of infrared radiation, and testing with the aid of a hot neutron flux. The resolutions of the various methods are indicated, as well as the possibilities of detecting different types of flaws by these methods. (IAA)

Nuclear Explosions

Refer also to abstracts 6494 and 6764.

6464 (UCID-16470) PRIMITIVE TWO-DIMENSIONAL CALCULATIONS OF THE EFFECTS OF REFLECTING LAYERS ON UNDERGROUND NUCLEAR EXPLOSION PHENOMENOLOGY. Hearst, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Mar 1974. Contract W-7405-eng-48. 27p. Dep. NTIS $4.50.

Two-dimensional Langrangian calculations were used to study the effect of a dolomite reflector on the cavity shape and pressure and the particle velocity field from a nuclear explosion in alluvium. Reflectors were placed at distances between 0.5 and 3 times the expected (no-reflector) cavity radius from the explosion point. Energy reflection coefficients were generally 0.8. The cavity was just perceptibly distorted with a reflector distance of 2 cavity radii, and distorted more with closer reflectors. The cavity pressure at about 90 ms was increased by about 25% with the reflector at 0.5 cavity radii, decreasing to about 10% with the reflector at 2 radii. Particle velocities and displacements at 1.5 and 2.3 cavity radii on the side of the explosion away from the reflector were affected only slightly, and only at quite late times. (auth)

6465 (UCID-16479) PERMEABILITY OF A NUCLEAR CHIMNEY AND SURFACE ALLUVIUM AT THE AEC NEVADA TEST SITE. Snoeberger, D. F.; Baker, J.; Morris, C. J.; Rozsa, R. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Apr 1974. Contract W-7405-eng-48. 18p. Dep. NTIS $4.00.

Permeability tests were conducted at a fourth nuclear-chimney site in alluvium and tuffs at the Nevada Test Site (NTS), and in

nearby surface alluvium at NTS. The calculated value of pressure diffusivity for both experiments is 0.1 m^2/s. Previously described methods were used for the measurement of atmospheric pressure and underground gas pressure, analysis of data, and fitting of calculated curves to measured pressure-time curves. (auth)

6466 A DIGITAL VELOCITY TRANSDUCER. Stone, R.R. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Rev. Sci. Instrum. 45: No. 1, 16-18 (Jan 1974).

A new velocity gauge that allows use of as many as 64 gauges per signal cable has been developed and tested. The gauge, designated "make-wire," uses moving wires contacting a printed circuit board to provide a digital signal consisting of a series of electrical offs and ons. The distance and the time between these discrete electrical changes are known; therefore, the velocity of the moving system can be determined. The gauge allows scaling up or down to obtain a sample exposure area as small as 0.6 cm^2. The gauges have been used in an underground nuclear effects test. The minimum velocity measured with the present configuration was estimated to be 50 cm/sec. (auth)

6467 EFFECT OF SHOCK ON FISSION TRACK DATING OF APATITE AND SPHENE CRYSTALS FROM THE HARDHAT AND SEDAN UNDERGROUND NUCLEAR EXPLOSIONS. Fleischer, R.L.; Woods, R.T.; Hart, H.R. Jr.; Price, P.B. (General Electric Research and Development Center, Schenectady, New York 12301); Short, N.M. J. Geophys. Res. 79: No. 2, 339-342 (10 Jan 1974).

Apatite and sphene crystals from granodiorite exposed to underground nuclear explosions were dated by the fission track method. The effect of shock pressure on the measured track densities and consequently on fission track ages was sought for samples taken from several different positions relative to the detonation point. For samples from the Hardhat event there is a decrease in track densities by 20–25% in apatite in the pressure range of 11–30 kbar and by 96% at 100 kbar; in sphene at least 90% are erased at 100 kbar. For samples from the same granodiorite shocked in the Sedan event there are no tracks in sphene and apatite above an estimated 350–400 kbar, and a few tracks still exist in apatite at pressures of 250–300 kbar, putting approximate limits on a threshold for total track erasure. Shock has not noticeably altered track cone angles. (auth)

Protective Structures and Equipment

6468 (WASH-1269, pp 199-244) LABORATORY AND PROCESS FACILITIES: TRAPPING AND REMOVAL. Dec 1973.

In tritium control technology.

Trapping and removal of tritium at various AEC and private installations are described. (TFD)

Vacuum Engineering

6469 THE TUNGSTEN EVAPORATION LIMIT OF HOT-CATHODE IONIZATION GAUGES. Angerth, B. (European Organisation for Nuclear Research, 1211 Geneva 23, Switzerland); Hulek, Z. J. Vac. Sci. Technol. 11: No. 1, 461-465 (Jan 1974).

Comparative measurements of pressures in the low 10^{-12}-Torr range with hot-filament total and partial pressure gauges have shown discrepancies which can be partly explained by the influence of tungsten vapor from the hot filament on the total pressure gauge readings (tungsten evaporation limit). The method proposed by Alpert and Buritz, with a slight modification, was used for estimates of the tungsten evaporation limit; i.e., a second filament served as an auxiliary source of evaporated tungsten atoms. Three gauges were tested, one gauge with a buried collector and two modulated Bayard–Alpert gauges. The experiments showed that the tungsten evaporation limits of all three gauges fell in the range $(1–2) \times 10^{-12}$ Torr (nitrogen equivalent pressure) with an electron emission of 10 mA. Provided the variation of the gauge sensitivity with the emission is known, it is recommended to operate at reduced emission (e.g., 4 mA), at which level the tungsten limit is substantially lower. Low-work-function emitters, as a means to obtain a low-temperature electron source, were not covered by the present study, which aimed at determining some performance limitations at very low pressures of a large number of existing gauges equipped with tungsten filaments. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 6531, 6532, and 6733.

6470 (AEC-tr-7532) OKLO PHENOMENON. Naudet, M. Translated from Bull. Inform. CETAMA; No. 4, 48-51(Nov 1973). 6p. Dep. NTIS $4.00.

The Oklo Phenomenon refers to an anomaly in the isotope content in natural uranium from deposits in Gabon. Routine assays revealed 0.7171 at. % of ^{235}U compared with a normal value of 0.7202 ± 0.0010 at. %. Further sampling showed some lots were degraded down to 0.621 at. %. Since 700 tons of uranium ore were affected, a deficiency of 200 Kg of ^{235}U resulted. A hypothesis was formulated that very ancient chain reactions within the deposit itself caused the ^{235}U anomalies. This hypothesis was confirmed by the discovery of fission products within the ore. Examination of the characteristics of the deposit showed that realization of the critical state was plausible and that a "fossile reactor" did in fact exist in the Franceville, Gabon uranium deposit. (LCL)

6471 (INIS-mf-887-3, pp 124-134) RADIOACTIVE CONTAMINATION OF WATERS IN THE NEIGHBOURHOOD OF URANIUM ORE MINING AND DRESSING PLANTS. Zavadsky, M.; Cechova, J. (Ustav Hygieny Prace Uranoveho Prumyslu, Kamenna, Czech). [nd]. (In Slovak).

The content was studied of natural U and of ^{226}Ra in the rivers of the Pribram uranium ore mining area and in the neighborhood of the MAPE uranium ore dressing plant. 1500 results obtained in the period between 1962 and 1970 revealed that neither the annual uranium content in surface waters in the Pribram area, nor the average ^{226}Ra content, seriously deteriorates the environment in the area; the values are tabulated. The situation was found similar also in the vicinity of MAPE. Sampling sites and the respective U and Ra concentrations in the period of 1966 to 1970 are listed. (INIS)

6472 PROSPECTING METHODS USED BY CEA IN NIGER AND THE RESULTS OBTAINED. Bigotte, G.; Molinas, E. (Groupement d'Actions de Recherches Minieres a l'Entranger, Marseille). Ind. Miner.; 56: No. 1, 2-16(Jan 1974). (In French).

The method used to locate uraniferous mineral deposits in the Agades region of Niger is described. The prospecting was conducted in different stages. At each stage the results obtained were interpreted geographically, the sedimentology, paleogeographic, and structural factors of the sedimentary basin studied being taken into consideration. A metallogenetic model was developed to describe the prevailing geological conditions. This model was modified as new measurements were made. Thus a continuously improved model was available during mining. In this way, the different uranium concentrates of the model were systematically found and the uranium deposit sought detected. The prospecting covered three distinct periods between 1959 and 1971: 1959 to 1962, a period during which information was obtained on the geological structure of the region; 1963 to 1966, a period during which information was obtained on the structure of the deposits; and 1966 to 1971, a period during which mining work was initiated. (FR)

6473 CORRELATION BETWEEN URANIUM AND TITANIUM IN CRYPTOGRANULAR PELITE. Gavshin, V. M.; Lavrent'ev, Yu. G. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geokhimiya; No. 2, 243-248(Feb 1974).

The uranium-bearing pelite from Devonian sandstones has been composed by dispersed particles of hydromica, chlorite, albite, and quartz. A correlation of uranium and titanium being dispersed in the pelite material has been found in one of the cryptogranular pelite fragments with the aid of radiography and electronic microprobing, the uranium–titanium ratio being in pelite higher than in minerals of the brannerite type. On the prevailing background of irregular dispersion finest grains of an uranium-titanium mineral are occasionally met. It is assumed that uranium concentration has been caused by the formation of metastable titanium hydroxide in pelite. (auth)

6474 GENETIC AND RADIATION NATURE OF THE METAMICT CHARACTER OF ZIRCONS (ACCORDING TO EXPERIMENTAL DATA). Krasnobaev, A. A.; Polezhaev, Yu. M.; Yunikov, B. A.; Novoselov, B. K. (Inst. of Geology and Geochemistry, Sverdlovsk, USSR). Geokhimiya; No. 2, 261-276(Feb 1974). (In Russian).

The metamict state of zircons is conditioned by the simultaneous influence of genetic and radiation factors of metamictization. Radiation disturbances cannot cause complete metamictization of zircons even for a time period being commensurable with the age of the Earth crust; a completely metamict state of zircons is inevitably connected with genetic premises. (auth)

6475 SUPPLY OF URANIUM. Hampel, H. R.; von Kienlin, A. (Urangesellschaft m.b.H. und Co. K. G.; Frankfurt am Main). Atomwirt., Atomtech.; 18: No. 7, 330-334(1973). (In German).

From reactor meeting; Karlsruhe, Germany (10 Apr 1973).

To maintain a satisfactory supply situation for uranium at favorable terms annual discoveries of 150,000 to 200,000 ton U_3O_8 are required in the near future. The costs of prospection and exploration amount to 2 up to 3 billion DM annually. The mining and milling capacities today exceed the demand but this may change very soon. The necessary investment for new capacities amounts to 0.5 up to 2.0 billion DM. These data relate to the western world. Five years ago two German enterprises for uranium supply had been founded in the FRG; Uranerzbergbau G.m.b.H. and Urangesellschaft m.b.H. In the meantime both firms have acquired or rather taken an option on a stock of uranium totalling 30,000 ton U_3O_8. (GE)

6476 DISTRIBUTION OF URANIUM IN SHELLS OF RECENT AND FOSSIL MOLLUSKS. Ogloblin, K. F.; Khalifa-Zade, Ch. M. (Azerbaidzhan State Univ., Baku). Geokhimiya; No. 2, 315-320(Feb 1974). (In Russian).

The results of a study of the uranium distribution in solid tissues of recent Pelecypoda and Gastropoda of the Caspian Sea and in shells of anthropogenic and Pliocene mollusks of Azerbaidzhan are reported. Factors affecting this distribution are discussed. (JSR)

Radioactive Effluents

Refer also to abstracts 6471, 6487, 6532, and 6537.

6477 (INIS-mf-887-3, pp 169-186) EFFECT OF RADIOACTIVITY OF THE WASTE WATERS FROM THE NUCLEAR RESEARCH INSTITUTES AT REZ ON THE ENVIRONMENT. Krepelka, J. (Ustav Jaderneho Vyzkumu, Rez, Czech). [nd]. (In Czech).

The sources of wastes, the concentration, and the disposal of wastes in the Nuclear Research Institute are described. Waste water radioactivity is checked intermittently; the method of measuring liquid wastes discharged is shown. The results are tabulated listing the type of radioisotope, its MPC in drinking water, and the volume activity of waste waters discharged in the period of 1963 to 1971. The gross beta activity was determined in the samples. A statistical evaluation was made showing that the amount of activity processed and its qualitative composition should be known as a prerequisite of a complex hygienic assessment of liquid waste disposal in large nuclear installations. (INIS)

6478 (NP-19964, pp vp, Paper 14) SOURCES OF RADIATION AND THEIR CONTROL. Eisenbud, M. (New York University Medical Center, NY). 1973.

In seminar on the engineering aspects of siting and operating power plants.

The growth of the nuclear power industry is reviewed and the radiation hazards associated with the release to the environment of reactor effluents is discussed. Information is included on: types of radioactive releases; limits on permissible release of radioactive wastes as imposed by the ICRP and EPA; radiation standards; somatic and genetic effects of ionizing radiation exposure; naturally occurring radiation sources; the application of radiation standards to reactors; and US AEC experience with the exposure of workers and the general public. It is concluded that nuclear power development involves a minimal and insignificant radiation hazard for the public. (LCL)

6479 HYDROLOGICAL SURVEILLANCE OF THE CADARACHE CEN SITE. Roux, F.; Chauvet, M.; Bisset, J. P. (Univ., Marseilles). pp 47-51 of Control of Ionizing Radiation: Pollution, Dosimetry, Applications. Marseilles; Centre National de la Recherce Scientifique (1973). (In French).

From 7th national congress of the Health Physicists's Association; Marseilles, France (16 May 1972).

The surveillance responsibilities delegated to the Institut de Recherches et d'Applications Medicales des Isotopes Radioactifs (IRAMIR) by the public authorities concern both the radioactive effluents prior to their disposal and the waters of the Basse

Durance. These two problems are considered successively. Analysis of the radioactivity and the dilution norms imposed for batches of effluents before their disposal are presented. A table of results representing two years surveillance is presented. (FR)

Radioactivity Monitoring and Transport

Refer also to abstracts 6478, 6641, 6707, 6708, 6714, 6733, 6734, 7173, 7468, 8727, and 8942.

6480 (BARC/I-249) ENVIRONMENTAL SURVEY AT TROMBAY REPORTED FOR THE PERIOD JANUARY 1, 1970 TO DECEMBER 31, 1972. Dey, N. N.; Kothari, B. U.; Ganapathy, S.; Shimpi, G. V.; Pillai, K. C. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 39p. INIS.

Results are presented of an environmental survey at Trombay for the period January 1, 1970 to December 31, 1972. During the period, 410 samples, sea water, suspended silts, bottom sediments, marine organisms, and salt and well water were collected and analyzed. The survey has shown that the concentration of radionuclides in the bay waters beyond discharge locations was below permissible limits. Both the bottom and shore sediments in the discharge locations and their close neighborhood show build-up of activity that requires watching. As a result of accumulation of radionuclides, the shore sediments contribute to the external exposure of persons occupying such areas. Organisms from the bay, especially benthic organisms from areas close to discharge locations, show accumulation of some fission product nuclides; however, the concentrations are below permissible limits. Consumption of salt produced from bay waters contributes less than 1% of the permissible dose. (auth)

6481 (CONF-7205103-(Absts.)) RADIOECOLOGICAL CONFERENCE: THEORETICAL AND PRACTICAL PROBLEMS OF THE CONTAMINATION OF THE ENVIRONMENT WITH RADIOACTIVE MATERIALS, STARY SMOKOVEC, CZECHOSLOVAKIA, MAY 16-19, 1972. Abstracts. (Slovenska Vedeckotechnicka Spolocnost, Kosice (Czechoslovakia). Komisia pre Jadrovu Techniku). 1972. 86p. (In Russian and Czech).

Abstracts of the proceedings of the Radioecological Conference concerning theoretical and practical aspects of radioactive contamination of the environment are compiled. (JSR)

6482 (COO-1199-38) STUDY OF RAINOUT OF RADIOACTIVITY IN ILLINOIS. Twelfth Progress Report. Semonin, R. G.; Gatz, D. F. (Illinois State Water Survey, Urbana (USA)). Apr 1974. Contract AT(11-1)-1199. 35p. Dep. NTIS $4.75.

Field experiments were continued to estimate convective storm particulate scavenging efficiency in proximity to the St. Louis, Missouri urban-industrial complex. Complimentary studies of the urban aerosol characterization, source strength, and removal processes were also studied. The 1973 field effort produced the following types of samples for analysis and interpretation: 1) 1513 total rain samples from 81 sites; 2) 450 sequential rainwater samples from 3 locations; 3) 266 wet/dry samples from 8 sites; 4) 270 air filter samples from 7 locations; 5) 81 Andersen impactor samples from 3 sites; 6) 14 water samples from aircraft in-cloud and precipitation at cloud base; and 7) 9 air filter samples from aircraft. The analysis procedures require that all water samples undergo filtering for separate analyses of soluble and insoluble fractions of the elemental concentrations. This data collection effort provided 4868 samples for chemical analysis. The status of the analysis of all types of data is described. The preliminary results of an attempt to estimate urban aerosol source coefficients and the source strength of St. Louis are presented. (auth)

6483 (EPA-680-4-73-1-b) ENVIRONMENTAL RADIOACTIVITY LABORATORY INTERCOMPARISON STUDIES PROGRAM, 1973-1974. (National Environmental Research Center, Las Vegas, Nev. (USA)). Feb 1974. 27p. GPO $0.65.

The U. S. Environmental Protection Agency's intercomparison studies program for laboratories involved in environmental radiation measurements is described. The types of environmental samples distributed, the analysis required for each sample, the distribution schedule, and the statistical analysis and reporting of results are discussed. Instructions and application forms are included for laboratories desiring to participate in the program. This document is designed for use by laboratories participating or desiring to participate in this quality assurance program. (auth)

6484 (MLM-2142) ANNUAL ENVIRONMENTAL MONITORING REPORT: CALENDAR YEAR 1973. Carfagno, D. G.; Westendorf, W. H. (Mound Lab., Miamisburg, Ohio (USA)). 25 Apr 1974. Contract AT-33-1-GEN-53. 37p. Dep. NTIS $4.00.

The environment surrounding Mound Laboratory was monitored and the results are reported for calendar year 1973. Samples analyzed included air, water, foodstuffs, soil, and silt. For radioactive species, the average concentrations of ^{210}Po, ^{238}Pu, and tritium detected were well within the stringent standards adopted by the Atomic Energy Commission and the Environmental Protection Agency. Data concerning nonradioactive species in air and water are also presented. Atmospheric monitoring for radioactive species was upgraded by the addition of 11 air sampling stations to the existing off-site network of ten continuous, high-volume air sampling stations. The average concentrations of ^{210}Po, ^{238}Pu, and tritium measured in air during this period were less than 0.07%, 0.3% and 0.2% of the respective Radioactivity Concentration Guide (RCG) values. Water monitoring for radioactive species showed the average concentrations of ^{238}Pu and tritium measured at the water sampling locations during this period to be less than 0.1% and 0.5% of the respective RCG values. Additionally, data concerning radioactive species in surface water, community drinking water, foodstuffs, and silt are presented. No significant uptake of radioactive species from air or water by plant or animal life has been observed. No reentrainment of radioactive species from soil or silt is indicated at this time. Soil core sample analyses will continue to establish a ^{238}Pu soil inventory as part of the total program to assess the impact of the Laboratory's operations on the environment. Water monitoring for nonradioactive species was conducted. Standards have been proposed for only three constituents of Mound's effluent streams. Their concentrations in the effluent streams are well within the proposed standards. These data reflect the effectiveness of Mound's Environmental Control Program and indicate that the operation of the Laboratory does not have a measurable effect on the environment. (auth)

6485 (SZS-152) RESULTS OF FALLOUT MONITORING IN THE GERMAN DEMOCRATIC REPUBLIC, 1971. Kunert, J.; Zindler, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Jul 1973. 45p. (In German). Dep. NTIS (US Sales Only) $5.25.

The results of monitoring of air, precipitation, fallout, water, soil, plants and foodstuffs are presented. The gross beta activity deposited on the territory of the GDR was higher than in the preceding year. This increase was caused by the influx of fresh fission products. However, an increase of the cumulative amount of ^{90}Sr and ^{137}Cs in fallout could not be detected unequivocally. In most of the other surveyed environmental samples no changes could be observed in comparison to 1970. Plants showed a nonuniform behavior concerning ^{90}Sr and ^{137}Cs contamination. Partially the concentrations determined differed considerably from the values expected as a result of the partly increased deposition during the corresponding growing seasons. (auth)

6486 SIGNIFICANCE OF ECOLOGICAL ANALYSES IN THE INTERPRETATION OF ENVIRONMENTAL RELEASES OF RADIONUCLIDES. Auerbach, S. I.; Vanderploeg, H. A.; Kaye, S. V.; Witherspoon, J. P. (Oak Ridge National Lab., TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 18-22(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The role that ecological analyses play in the collection and interpretation of environmental measurements that are part of surveillance programs near nuclear facilities is reviewed. The subjects discussed include: pathways of radionuclide migration in ecosystems; bioaccumulation factors; environmental measurements; and modeling and mathematical simulation. (LCL)

6487 ENVIRONMENTAL SCIENCE. Turk, A.; Turk, J.; Wittes, J. T.; Wittes, R. Saunders Golden Series. Philadelphia; W. B. Sanders Company (1974). 576p. $12.95.

A chapter on energy includes discussions of energy consumption, energy and power, heat engines, fossil fuels, transportation of fuels, nuclear fuels, renewable energy sources, electricity, thermal pollution, and waste heat. A chapter on radioactive pollutants includes discussions of natural radioactivity, nuclear fission reactors, environmental hazards, nuclear fusion, and biological effects of radiation. An additional eleven chapters discuss the ecology of natural systems, human adaptation to environmental change, the extinction of species, the growth of human populations, agricultural systems, control of pests and weeds, air pollution, water pollution, solid wastes, noise, and social, legal, an economic aspects of environmental degradation. (HLW)

6488 SAFETY MEASURES IN A NUCLEAR CENTER IN VIEW OF PROTECTING THE ENVIRONMENT. Marichal, M.; Peyresblanques, H. (Centre de Marcoule, Bagnols-sur-Ceze, France). pp 19-34 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From seventh national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The functioning of industrial nuclear centers involves potential hazards both during normal operation and in the event of an accident. Special measures and precautions must be taken first, for the nuclear installation and then for the environment. Under normal operating conditions, a complete knowledge of the gas, liquid, and solid wastes is required in order to ensure a minimum or zero environmental damage. A very strict intervention plan has been drawn up for the case of an accident. This plan would limit and enclose the dangers from radioactivity. (FR)

6489 EXPERIMENTAL AND ANALYTICAL RADIATION DOSIMETRY NEAR A LARGE BWR. Lowder, W. M.; Gogolak, C. V. (Atomic Energy Commission, New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 423-429 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The stringent limits proposed for off-site population exposure to radiation of facilities origin allow little conservatism in the methodology of dose assessment. Experiments in the environs of a large boiling water reactor (BWR) are being made to determine ion chamber and TLD techniques for measuring annual gamma radiation exposures of 0.1 to 10 mR from the gaseous effluent and to evaluate the accuracy of the dose predictions of several analytical models of radionuclide and photon transport. The development of accurate experimental techniques for low-level dose assessment should also be important for facilities where airborne releases occur intermittently ("puffs") or where the source is poorly defined ("seepage"). (auth)

6490 RADIOLOGICAL ENVIRONMENTAL MONITORING: THE EPA APPROACH. Rowe, W. D. (Environmental Protection Agency, Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 416-422(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Environmental monitoring is a necessity in this Nuclear Age. Monitoring programs, however, must be designed so that needed information is obtained in a cost-effective manner without redundancy among Federal, State, and local agency programs. The approach of the U. S. Environmental Protection Agency to monitoring is discussed, with emphasis on dose computation utilizing source data, environmental models, and minimal monitoring for validation. The compatible role of State and local agency monitoring programs is also presented. (auth)

6491 ENVIRONMENTAL RADIATION DOSE CRITERIA AND ASSESSMENT: PATHWAY MODELING AND SURVEILLANCE. Hull, A. P. (Brookhaven National Lab., Upton, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 491-495 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The controversy in recent years over the extent of the risk to the public from environmental radioactivity attributable to nuclear facilities (in particular nuclear power plants and fuel reprocessing facilities) has resulted in a lowering of previously "acceptable" environmental radiation levels. The proposal by the AEC to limit effluents from light-water-cooled nuclear reactors so that the exposure of any individual in the public would not exceed 5 mR/yr, and the pronouncement by the BEIR Committee that the current environmental radiation protection guides are unnecessarily high, are illustrative. In turn the AEC has issued a Safety Guide calling for considerable refinement in the measuring and reporting of effluents from nuclear power plants, and has only recently issued a counterpart dealing with the measuring and reporting of radioactivity in the environs of nuclear power plants. The EPA has also recently issued a guide for the surveillance of environmental radioactivity. Currently, power reactor operators are being required by the AEC Regulatory Staff to conduct detailed, sensitive environmental surveillance, at levels consistent with the proposed concentration limits of Appendix I. Much of this appears to be based on extremely conservative assumptions throughout, including dose-effect relationships, exposure situations, pathway models, reconcentration factors and intakes, which cannot be substantiated when examined in the light of current experience in the vicinity of existing power reactors. The expenditures occasioned by the required additional in-plant features necessary to meet the currently proposed effluent release criteria appear difficult to justify on a reasonable basis. Those for environmental monitoring at the proposed concentration limits appear even more excessive in terms of dollars per man-rem of potential dose commitment. (auth)

6492 ^{55}Fe CONCENTRATION AND SPECIFIC ACTIVITIES IN NORTH PACIFIC MARINE ORGANISMS. Jenkins, C. E.; Langford, J. C. (Battelle Pacific Northwest Labs., Richland, WA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 517-521(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Marine organisms have been shown to have up to 1000-fold higher specific activities of ^{55}Fe than that in seawater. It was also shown that ^{55}Fe specific activities increase 10- to 30-fold in salmon between mid and northern latitudes. These observations are currently explained on the basis of a different chemical form for ^{55}Fe in seawater and greater dilution of the ^{55}Fe by stable iron at mid-latitudes than at the northern latitudes. The half-time for ^{55}Fe concentrations in mature harvested salmon at all latitudes is approximately 10 months, which is comparable to the half-time for movement of stratospheric debris to the earth's surface. This observation precluded the possibility that early tropospheric deposition of ^{55}Fe from the 1961-62 Russian nuclear tests contributed significantly to the long-term concentrations of ^{55}Fe in marine biota. (auth)

6493 PLUTONIUM: A REVIEW OF MEASUREMENT TECHNIQUES FOR ENVIRONMENTAL MONITORING. Budnitz, R. J. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 430-437(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

An overview is provided of the techniques for measuring plutonium in various media. The emphasis is on measurements for surveillance and protection in environmental and occupational situations. Overviews are first provided for the characteristics of, sources of, and typical levels of plutonium concentrations. The various measurement techniques are then discussed. (auth)

6494 DATA. Section IV. Other Data. Radiat. Data Rep.; 15: No. 3, 134-159(Mar 1974).

Environmental monitoring data obtained during January through December 1971 near the Mound Laboratory, Miamisburg, Ohio and the National Reactor Testing Station site, Idaho, are reported. For the Mound Laboratory, the tabulated data include the ^{238}Pu, ^{210}Po, and tritium content in surface air, in on- and off-site surface waters, in community drinking water in the environs, and in foodstuffs and vegetation, and the ^{238}Pu levels in soils, river sediments, and pond sediments. For the NRTS, the tabulated data include the: gross α, gross β, and radioisotopes content in surface air; gross α, gross β, and tritium in well water and offsite drinking water and surface waters; ^{137}Cs, ^{131}I, and ^{90}Sr content in milk, and the ^{90}Sr content in wheat. Miscellaneous information is included on the December 1971 status of present and proposed US nuclear power plants and the detonation of a 20 to 200 Kt yield underground nuclear explosion at the Nevada Test Site on February 27, 1974. (LCL)

6495 RADIOLOGICAL SURVEILLANCE AROUND TURKEY POINT, 1970-1971. Johnson, W.; Eakins, J. (Dept. of Health, Jacksonville, FL). Radiat. Data Rep.; 15: No. 3, 105-115(Mar 1974).

Prior to the operation of the Turkey Point Nuclear Power reactor, environmental media were sampled and data are presented for 1970-1971. Basic media investigated include air, precipitation, soil, silt, and water, including sea water. A number of media utilized as indicator organisms serve to investigate the behavior of radionuclides in several ecological levels. Indicators are mangrove vegetation, fresh water algae, turtle grass and sponges. Additional items found in the human food chain that were analyzed include crustacea, fish, and food crops. (auth)

6496 ENVIRONMENTAL CONTROL IN NUCLEAR FUEL REPROCESSING. Platt, R. B. (Emory Univ., Atlanta); Palms, J. M.; Ragsdale, H. L.; Shure, D. J.; Mayer, P. G. Chem. Eng. Progr.; 70: No. 4, 87-88(Apr 1974).

Complete manuscript (MS No. 5660) available from American Institute of Chemical Engineers, New York for $6.00.

The environmental radiation monitoring program in use at the Barnwell Nuclear Fuel Reprocessing Plant since June 1970 is described briefly in terms of the program objectives, monitoring activities undertaken to detect contamination in aquatic, terrestrial, and atmospheric ecosystems, and the reliability of the program for detecting increases in environmental levels of effluents. (LCL)

6497 HEALTH PROTECTION AND THE CONTROL OF ENVIRONMENTAL RADIOACTIVE POLLUTION. Cigna, A. A.; Faloci, C.; Polvani, C. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 20: No. 2, 25-29(Feb 1974). (In Italian).

The very low degree of the environmental radioactive contamination existing in Italy is reported, together with the research and surveillance actions underway. After reviewing the main contamination sources and the meaning of the health and environmental standards of radiation protection, the organization of controls in Italy is described with particular reference to the national and local sampling networks, the measurement centers, the number and type of measurements performed, and the wide spreading of the publications concerning the results, carried out by CNEN. Intake evaluations by the average individual in the Italian population for some fallout radionuclides during the last 20 years are reported. (auth)

6498 MEANS OF EVALUATION OF POPULATION DOSE FROM NATURAL BACKGROUND RADIATION FOR CONTROL OF EXPOSURE IN THE ENVIRONMENT OF NUCLEAR POWER PLANTS. Pensko, J. (Instytut Badan Jadrowych, Swierk, Poland). Nukleonika; 19: No. 1, 47-56(1974). (In Polish).

The methods used and the results of calculations of the average value of the equivalent of the dose of the natural background of radiation affecting the gonads and the bone marrow are presented with the inhabitants of one of the regions of Poland chosen as an example. These values, weighed on a number of more important environmental factors, amounted to 78.0 mrem/year for gonads and 72.1 mrem/year for bone marrow. The value of the total population dose for the investigated region, from these sources of radiation, does not exceed 1.2×10^4 man-rem/year. Calculations were performed mainly on the base of the results of measurements of the exposure dose rate by a scintillation monitor from aboard an airplane, using also the numerous measurements of the dose at the height of 1 m over the earth's surface, done by means of a high-pressure ionization chamber, and the results of gamma spectrometric analysis of samples of soil. In calculations, coefficients of transformation of the exposure dose into the dose absorbed by various tissues, and the time spent indoors, were taken into consideration. For this purpose, using a proper coefficient of building screen has been suggested. This method can be used for estimating the average population dose from the external radiation originating from natural and artificial radioactive sources present in the environment of nuclear power plants. (auth)

Atmosphere

Refer also to abstracts 5865, 6429, 6606, 6640, 7140, 8728, and 8972.

6499 (ARMS-69.6.5) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE AREA SURROUNDING THE MILLSTONE NUCLEAR POWER STATION, WATERFORD, CONNECTICUT, AUGUST 29 AND SEPTEMBER 11, 1969. (EG and G, Inc., Las Vegas, Nev. (USA)). May 1974. 16p. (EGG-1183-1588). Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to survey the area surrounding the Millstone Nuclear Power Station during August 1969. The survey measured terrestrial background gamma radiation. A high-sensitivity detection system collected gamma spectral and gross-count data. The data were then computer processed into a map of a 450 square mile area showing isoexposure contours three feet above the ground. Exposure rates and isotopes identified are consistent with normal terrestrial background. (auth)

6500 (BARC-732) MEASUREMENTS OF SHORT-LIVED RADON DAUGHTERS IN THE ARABIAN SEA AND INDIAN OCEAN REGION DURING MONEX-1973. Rangarajan, C.; Gopalakrishnan, S. S.; Eapen, C. D. (Bhabha Atomic Research Centre, Bombay (India)). 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

MONEX-73 was a weather research project conducted during May to mid-July 1973 for studying the origin, structure, and characteristics of the Asian summer monsoon over the Arabian Sea. During the project radon daughters' activity was measured in surface air at various locations over the Arabian Sea-Indian Ocean region in order to determine the variations in radon daughters in the area and to study the effect of monsoon winds on radon daughter level at inland areas. The experimental procedures and results are reviewed. These experiments showed that: low levels of radon daughter activity in the equatorial zone indicate the absence of continental air from Africa at surface levels in these ocean regions; radon daughter activity increases with increasing north latitude, and at 20°N is about ten times the equatorial zone value; large quantities of southerly air reach Bombay during the monsoon; more sensitive instruments than were used should be used for measuring ThB over the oceans; and simultaneous measurements of radon levels in various regions of the Indian Ocean are needed to trace the mixing of equatorial and continental air. (LCL)

6501 (CEA-CONF-2475) INFLUENCE OF EXPOSURE DURATION ON THE EVALUATION OF THE ATMOSPHERIC DIFFUSION COEFFICIENTS. Brun, J.; Hugon, J.; Le Quinio, R. (CEA, 75-Paris (France)). 1972. 24p. (In French). (CONF-731110-7; SM-181-11). Dep. NTIS (US Sales Only) $4.25.

From symposium on the physical behavior of radioactive contaminants in the atmosphere; Vienna, Austria (12 Nov 1973).

From general studies on atmospheric diffusion from a continuous source, fragmentary results permitted the evaluation of the effect of the sampling duration on the maximum concentrations of the emitted effluent. In the course of about 19 systematically organized releases, the results obtained when the sampling duration varies from $\frac{1}{4}$ hr to 4 hrs were compared. The principal results obtained are described and examined with respect to those obtained by taking into consideration the fluctuations of the wind direction. (tr-auth)

6502 (FOA-4-4570-A-1) RADIOACTIVITY FROM NUCLEAR WEAPONS IN AIR AND PRECIPITATION IN SWEDEN FROM MID-YEAR 1968 TO MIDYEAR 1972. Bernstroem, B. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1974. 32p. Dep. NTIS (US Sales Only) $4.75.

The concentrations of various fission products in ground level air and precipitation from mid-year 1968 to mid-year 1972 are reported. Since 1963 the ^{137}Cs concentration in surface air decreased each year to 1967. After a small increase 1968 the air concentration of ^{137}Cs remained on the same level until 1971 and decreased in 1972 to the lowest level reported since the measurements started. Short-lived ^{140}Ba was detected in ground level air after the Chinese explosions in December 1968, November 1971, January 1972, and March 1972. After the Chinese tests in September 1969 and October 1970 the concentration of ^{140}Ba was below the detection level. (auth)

6503 (RFP-ENV-73) ANNUAL ENVIRONMENTAL MONITORING REPORT: ROCKY FLATS PLANT, JANUARY THROUGH DECEMBER 1973. Werkema, G. J.; Thompson, M. A. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 26 Apr 1974. Contract AT(29-1)-1106. 37p. Dep. NTIS $5.00.

Results of the environmental monitoring program in the Rocky Flats vicinity indicate the average environmental concentrations of ^{239}Pu in air and water during 1973 were less than 2% of applicable U. S. Atomic Energy Commission Radioactivity Concentration Guides. Average concentrations of ^{241}Am and tritium in water samples were less than 1% of applicable U. S. Atomic Energy Commission Radioactivity Concentration Guides. The annual average concentrations of residual chlorine, settleable solids, and turbidity in Rocky Flats sewage plant effluent did not meet the new wastewater discharge standards promulgated by the Colorado Department of Health in 1973. (auth)

6504 (RT/PROT-73(16)) STATISTICAL ANALYSIS OF SURVEY NETWORKS OUTPUT DATA FOR STUDYING MG SAMPLING POINTS DENSITY AND DISTRIBUTION. Mastinu, G. G.; Zuccaro Labellarte, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1973. 15p. INIS.

From 2nd IRPA congress; Brighton, UK (May 1970).

By applying linear regression to the data yielded by the Italian survey networks for air and milk, it was found that the values measured at the various sampling points may be extended to wider areas, whose size depends on the presence of fresh fission products and on the meteorological events. The possibility of application of this method to other networks, as well as its limits, are discussed. (auth)

6505 WIRE SCREEN-FILTER PAPER COMBINATION FOR THE MEASUREMENT OF FRACTIONS OF UNATTACHED RADON DAUGHTERS IN URANIUM MINES. Raghavayya, M.; Jones, J. H. (Bhabha Atomic Research Center, Bombay). Health Phys.; 26: No. 5, 417-429(May 1974).

Lack of current actual field data on such factors as radon daughter equilibrium ratios and fractions of unattached radon daughter atoms and the relationship of the measured working levels to actual lung dose has caused questioning of the working level concept as the basis for mine radiation control work. A simple technique is described for measuring equilibrium ratios and the fractions of unattached radon daughter atoms in air using a wire screen prefilter to collect unattached atoms. Values obtained by this method in several United States uranium mines are presented. (auth)

6506 BASELINE GROUND-LEVEL AIRBORNE RADIONUCLIDE SURVEY FOR A NUCLEAR FUEL REPROCESSING PLANT. Palms, J. M. (Emory Univ., Atlanta); Tanner, B. K.; Wood, R. E.; Boone, F. W. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 585-595(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The ground-level airborne radionuclide concentrations and the resulting dose to man have been measured in the vicinity of Barnwell, S. C., during 1971, 1972, and 1973. These measurements, which were made as part of a preoperational baseline study for a nuclear fuel reprocessing plant, include gross alpha-beta and high resolution Ge(Li)-NaI(Tl) gamma-ray spectrometry using air filters, tritium (HTO) measurements using silica gel, and dose measurements using LiF thermoluminescence dosimeters. The observed levels of approximately 20 nuclides can be explained by contributions from worldwide fallout, natural process and naturally occurring terrestrial nuclei, and normal seasonal variations. There has been a considerable decline in levels during the latter part of 1972 and first half of 1973. The average annual dose to man resulting from inhalation of most of the measured nuclei is only a very small fraction of the total dose received from normal background sources. (auth)

6507 MEASUREMENT OF SOURCES OF IODINE-131 RELEASES TO THE ATMOSPHERE FROM NUCLEAR POWER PLANTS. Pelletier, C. A.; Cline, J. E.; Keller, J. H. (Nuclear Environmental Services, McLean, VA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 478-483(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Measurements of ^{131}I at operating BWR's recently reported by the AEC are evaluated in terms of proposed "as-low-as-practicable" regulations. Comparisons are made between measured releases and those calculated using a mathematical model developed by ORNL and used by the AEC in licensing nuclear power plants. It is concluded that ^{131}I releases in ventilation exhaust air are significant with respect to proposed regulations. Using methods given in Regulatory Guide 1.42, it is shown that releases may be 10 times higher than those which would give a potential dose of 15 mRem/year at the site boundary. It is shown that about one-half of the ^{131}I in ventilation air was elemental during power operation. During a refueling shutdown at one plant the average release rate of ^{131}I was 3 times that during power operation, but only a small fraction was elemental. It is concluded that the ORNL model did not represent the processes leading to the appearance of ^{131}I in ventilation exhaust air, although in the aggregate the agreement between calculated and measured releases was very good. (auth)

6508 ENVIRONMENTAL DOSE MEASUREMENTS IN THE VICINITY OF NUCLEAR FACILITIES. Hall, R. M. Jr.; Ross, D. I. (E. I. du Pont de Nemours and Co., Aiken, SC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 451-455(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The environmental monitoring program at the Savannah River Plant (SRP) is described, and some of the data obtained to date with the expanded system are summarized. (auth)

6509 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 15: No. 3, 132-133(Mar 1974).

July 1970 to July 1972 measurements are reported for the ^{85}Kr concentrations in surface air at 16 US sites that are near existing or proposed nuclear facilities. (LCL)

6510 STUDIES OF THE THORON, RADON, AND DECAY PRODUCT CONTENT OF THE ATMOSPHERE AT BADGASTEIN WITH A DOUBLE-FILTER APPARATUS. Maerk, T. D.; Pohl, E. (Oesterreichische Akademie der Wissenschaften, Vienna). Oesterr. Akad. Wiss., Math.-Naturwiss. Kl.; 180: No. 8-10, 327-362 (1973). (In German).

The peculiarity of the radioactive environment of Badgastein arises from the fact that there are 19 thermal springs in the center of the village that produce some 5 million litres of water per day with an average radon content of 40 nCi/l. About 60% of the radon dissolved in the water escapes into the surrounding air while the water is still in the spring galleries and reservoirs; still more escapes in the bathing facilities. As has already emerged in earlier investigations, the radon content of the atmosphere in Badgastein, both out-of-doors and in living and working spaces, is appreciably greater than at other locations with similar geological characteristics. In the present work, a double-filter setup is described which permits simultaneous measurements of thoron (Th, Rn 220), radon (Rn, Rn 222), RaB (Pb 214) and ThB (Pb 212) contents. The measurement of the concentration of short-lived Th is even possible in the presence of more than 10000 times higher concentrations of Rn. Measurements in the open air taken at points on the perimeter of the village during the late summer showed no diurnal variation in the short-lived Th activity in contrast to the observations on the longer-lived nuclides Rn, RaB and ThB which on the average gave higher readings in the mornings than in the afternoons. No statistically significant correlations could be found between the various radionuclide concentrations and meteorological parameters such as thermal and barometric fluctuations. Nor was any significant correlation found between the Th and ThB content, although correlations were found both between Rn and RaB and between Rn and ThB. In the open air the ratio RaB/Rn only fluctuated over a range from 0.5 to 0.8 whereas in the air in the spring galleries and bathing areas, the ratio fluctuated over a far greater range (from 0.03 to 0.6), as did the ThB/Th ratio (from 0.0004 to 0.01). These findings can only be attributed to variations in the ratio of emission of radioactive emanations and in the variations in ventilation. Further studies were also made in the "Thermalstollen" used for Rn-inhalation therapy at Badgastein/Böckstein. (auth)

6511 SECOND JOINT CONFERENCE ON SENSING OF ENVIRONMENTAL POLLUTANTS, WASHINGTON, DC, DECEMBER 10-12, 1973. Pittsburgh; Instrument Society of America (1973). 383p. (CONF-731205-).

Session topics for the conference were: remote passive sensing of atmospheric pollutants; extension of laboratory measurement techniques for field use; instrument quality and measurement standardization; remote active sensing of atmospheric pollutants; stationary source sensing; air quality standards and measurement accuracy; radiological, electromagnetic, and acoustic pollution monitoring; new methods in particulate analysis; measurement of meteorological variables that impact on atmospheric pollutants; impact of meteorological parameters on pollution analysis; in-situ sensing of acoustic chemical and biological pollutants; global scale pollution monitoring; and remote sensing of water pollutants. One of the 45 papers presented was indexed separately. (LK)

For an abstract of an individual paper see: 5894.

Soil

Refer also to abstracts 5893, 6731, and 6735.

6512 (ARMS-73.6.2) GROUND BASED OBSERVATIONS SUPPORTING THE SHIPPINGPORT, PENNSYLVANIA, AERIAL RADIATION SURVEY OF FEBRUARY 1973. (EG and G, Inc., Las Vegas, Nev. (USA)). May 1974. 16p. (EGG-1183-1597). Dep. NTIS $4.00.

Soil samples and tissue-equivalent dose measurements were obtained at three ground sites beneath two aerial flight lines in the Shippingport, Pennsylvania, survey area. This work was done in support of the aerial radiological survey at Shippingport on February 24, 1973. The soil samples contained naturally occurring isotopes and ^{137}Cs only. The ^{137}Cs concentration varied from 0.46 to 0.85 pCi/g of dry soil. The tissue-equivalent dose measurements ranged in value from 7.8 to 9.5 μRad/hr, and compare well with the gamma exposure rates measured by the Aerial Radiological Measuring System (ARMS). (auth)

6513 (HASL-282) COMPUTER PROGRAM FOR CALCULATING VARIOUS PARAMETERS RELATED TO SOIL-WATER BALANCE. Burke, G.deP.; Marcin, D. G. (USAEC Health and Safety Lab., New York). Apr 1974. 60p. Dep. NTIS $5.45.

A computer code for the routine calculation of various climatic parameters was developed based on a soil-water balance model developed by Thornthwaite and Mather. The parameters calculated are useful for correlation with time changes of the environmental gamma radiation exposure caused by variations in the density of the soil water medium and the amount of surplus water on the surface acting as a shield against radiation from the ground. Required input to the code includes information on general soil and vegetation type, soil water holding capacity, hours of sunlight, and routine Weather Service temperature and precipitation data. Output includes values of water storage, water surplus and deficit, and actual evapotranspiration. The code, job rain, is written in Fortran IV for an IBM 360-30 and is listed in the report. (auth)

6514 (INIS-MF-887-3, pp 2-13) RADIOISOTOPES IN THE SOIL-SOLUTION SYSTEM. Kulikov, N. V.; Molchanova, I. V. [nd]. (In Russian).

The effect was studied of certain factors on the migration and the distribution in the soil-solution system of the radioisotopes

^{59}Fe, ^{60}Co, ^{90}Sr, ^{91}Y, ^{137}Cs, and ^{144}Ce. Experiments were carried out using four types of soil having different physico-chemical properties. The results show that the degree of sorption of all radioisotopes concerned is determined by the chemical nature of the radioisotopes and does not depend on the physico-chemical properties of soils. Also, the effect of complexones (EDTA) on sorption was studied; the results are shown in graphs. The desorption of the radioisotopes by various desorption agents showed that the degree of fixation of the radioisotopes into soils depended on the individual properties of the elements and on the physico-chemical properties of soils alike. Thus, the migration capability of radioisotopes was found to depend both on their chemical properties and on the physico-chemical properties of soil and soil solutions. (INIS)

6515 (INIS-mf-887-3, pp 45-52) SORPTION AND DESORPTION OF RADIONUCLIDES BY CZECHOSLOVAK SOILS. Benes, J. (Ceskoslovenska Akademie Ved, Prague). [nd]. (In Czech).

The results are outlined of a study on the sorption properties, for the separation of ^{90}Sr and ^{137}Cs, of five basic types of soil. The composition and the chemical and physico-chemical properties of the soils studied were determined. A study of the competitive effect of various cations on strontium and cesium sorption showed no pronounced effect of these cations at concentrations not exceeding approx. 10^{-4} M. Desorption from soils was studied under both static and dynamic conditions. Under static conditions, the desorption of ^{137}Cs was considerably affected by the solution volume; it proceeded best with a 1N chloride solution, or with a solution of potassium or ammonium acetate. The desorption of ^{90}Sr was best with a 0.1N calcium chloride solution. The radionuclide content in plants was also checked, and a method was elaborated of determining ^{90}Sr, ^{137}Cs, and ^{131}I. The data on ^{137}Cs activity levels in basic cereals and leguminous plants are tabulated. (INIS)

6516 (INIS-mf-887-3, pp 63-76) GEOCHEMISTRY OF ^{90}Sr AND ^{137}Cs IN SOILS OF USSR. Tyuryukanova, E. B.; Vostokova, T. A.; Belyaeva, L. T.; Konova, N. I.; Emelyaov, V. V. [nd]. (In Russian).

The distribution and the migration was studied in various areas of the USSR of ^{90}Sr and ^{137}Cs for the period of 1960 to 1970. Methods are listed of the sampling of ^{90}Sr and of its activity determination by means of its daughter ^{90}Y. Flood lands were found to play a special role in radionuclide migration. Observations in soil-geochemistry areas, i.e. in the areas of secondary accumulation, showed that the accumulation of ^{90}Sr proceeded more slowly and to a lesser extent than that of Sr, Ca, and other elements. A study of the characteristics of ^{90}Sr and of ^{137}Cs migration in soils shows that the migration is largely affected by the characteristics of a given area and its geochemical conditions. ^{90}Sr and ^{137}Cs redistribution during the migration of the radionuclides with solid and liquid erosion products results in the formation of secondary accumulation sites. (INIS)

6517 (INIS-mf-887-3, pp 77-88) DISTRIBUTION OF ^{90}Sr INTO GROUPS AND FRACTIONS IN ORGANIC MATTER OF SOILS. Pavlotskaya, F. I.; Blokhina, M. I.; Arnautov, G. N. [nd]. (In Russian).

The nature of the distribution of ^{90}Sr, Ca, Fe, and Al into the respective groups and fractions of the organic matter of soil is explained, and the forms which they assume in the fractions concerned are listed. The tabulated results show that a considerable amount of ^{90}Sr is linked to the organic matter of soils, and after the precipitation of humus acids, another considerable part is linked to acid solutions. In the soils investigated, the principal part of ^{90}Sr was linked to the components of organic substances with lower molecular weight. ^{90}Sr can be found in soils in the form of a complex compound containing humus acids, specific organic substances, minerals, Ca, Fe, Al, and other elements. Depending on the solubility of the compounds the proportion of ^{90}Sr in mobile state increases or decreases. (INIS)

6518 (INIS-mf-887-3, pp 89-94) ^{90}Sr MIGRATION FROM SOILS TO RIVERS. Bobovnikova, Ts. I.; Shulenko, Z. S. [nd]. (In Russian).

Contamination was investigated of rivers in the area below Moscow with ^{90}Sr from soils and fallout. In areas of normal precipitation in the period of maximum fallout, ^{90}Sr in rivers from this fallout amounts to 35 to 40% and decreases to one half every following year. The amount of ^{90}Sr washed out from the soils in the period of maximum fallout amounts to 35 to 55% and increases to up to 70% in the following years. On the average, in the area of normal precipitation, the rate of ^{90}Sr washed out from the soils into the rivers is 0.4%, in areas of subnormal precipitation 0.25% and in areas of considerable precipitation 1%. (INIS)

6519 (INIS-mf-887-3, pp 95-112) PRESENT LEVEL OF GLOBAL CONTAMINATION AND THE NATURAL RADIOACTIVITY OF SOILS. Boltneza, L. I.; Izraehl', Yu. A.; Ionov, V. A.; Nazarov, I. M.; Stukin, E. D. [nd]. (In Russian).

A variety of factors related to geographical and climatic conditions was observed in the investigation of the distribution of ^{90}Sr and ^{137}Cs in soils. The level of contamination depends on precipitation, it increases in mountainous areas, is dependent on geographical latitude and it has also been observed that there are certain areas where contamination with ^{137}Cs is different than in the neighboring areas. In this connection a certain analogy was observed with the map of precipitation. The ^{137}Cs gamma radiation dose rates were determined for different types of soil in relation to the amount and depth of location. (INIS)

6520 (INIS-mf-1032) INTERACTION OF RADIOACTIVE ISOTOPES WITH ORGANIC SOIL MATERIAL. Vodovozova, I. G.; Zaidman, S. Ya.; Antropova, Z. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 15p. (In Russian). INIS.

By extracting the organic soil matter by means of KU-2 it is possible to isolate the organic fraction in a less changed form than with pyrophosphate isolation, and this method can be applied in studying the interaction of organic soil matter with radioisotopes. As a result of studying the interaction of organic matter with radioisotopes, quantitative data has been obtained on the binding characteristics of ^{90}Sr, ^{45}Ca, ^{137}Cs and ^{91}Y with organic matter isolated from three soils: turf-podzolic, gray forest and chernozem (black earth). The interaction of ^{90}Sr, ^{45}Ca, ^{137}Cs and ^{91}Y is different in the presence and absence of stable analogous elements. (tr-auth)

6521 (INIS-mf-1036) MIGRATION OF STRONTIUM-90 AND CESIUM-137 IN SOILS. Tyuryukanova, E. B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1972. 11p. (In Russian). INIS.

Geochemical migration and the redistribution of ^{90}Sr and ^{137}Cs is a slow process taking place over an extended period of time. At present an undeviating decrease in ^{90}Sr content is observed in soils of watersheds, and an increase of ^{90}Sr is observed in bottomland soils. ^{90}Sr migrates faster than ^{137}Cs. In forest soils of watersheds the migratory ability of the radioisotopes depends on features of the forest litter. A local soil-geochemical barrier, in which ^{90}Sr and ^{137}Cs accumulate, is the coarse humus litter (A_0'). In bottomlands the secondary accumulation of ^{90}Sr is connected with processes of the hydrogenic accumulation of ^{137}Cs—with mechanical infiltration (in the form of sediments deposited by water). (SJR)

6522 (INIS-mf-1037) AQUEOUS MIGRATION OF STRONTIUM-90. Tyuryukanova, E. B.; Konova, N. I.; Emel'yanov, V. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 15p. (In Russian). INIS.

A study was carried out on the ^{90}Sr content of soil water, ground water and river water. It is shown that the elution of ^{90}Sr from soil with runoff water depends to a significant degree on features of soil processes, plant cover, relief, type of high water flooding, and weather characteristics. Variation in soil cover causes a variation in the behavior of ^{90}Sr. A change in content of oxygen, carbon dioxide, carbonate, bicarbonate, et al, causes a change in the behavior of ^{90}Sr. Some years active elution of ^{90}Sr is observed, and in other years there is accumulation of ^{90}Sr. This evidence indicates that ^{90}Sr is not held firmly by ground water, and its behavior in soil has not yet been established. In connection with the fact that ^{90}Sr eluted from the soil does not all appear in river water but is partially retained in local geochemical barriers, the average annual elution of ^{90}Sr by river water is significantly less than its elution from soils. (SJR)

6523 (INIS-mf-1040) RELATIVE MOBILITY, STATE AND FORMS OF EXISTENCE OF STRONTIUM-90, STABLE STRONTIUM, AND CALCIUM IN SOILS. Pavlotskaya, F. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 39p. (In Russian). INIS.

The purpose of the study is to generalize the data obtained on the relative mobility, state and forms of existence of ^{90}Sr, stable strontium and calcium in soils as a function of the time of carrying out of the experimental nuclear blasts and of an ensemble of various natural factors. Observed differences in the mobility of ^{90}Sr, stable strontium and calcium in various types of soils are caused by quantitative differences in content in water-soluble, exchange and non-exchanging states, and also in the forms of existence in the water-soluble state (cationic, anionic or neutral). The form of existence in turn is determined by the physical-chemical properties of the soils and their genetic structure, by agro-meteorological conditions, by the type of plant cover, by

sources of entry into the soil, and by the time of interaction with the soil. The high mobility of ^{90}Sr in comparison with stable strontium indicates that isotopic exchange requires time and that complete isotopic equilibrium has not yet been attained. This fact should be kept in view in studying the biogeochemical aspects of the behavior of these isotopes. (SJR)

6524 (INIS-mf-1043) MIGRATION OF STRONTIUM-90 AND CESIUM-137 IN SOIL–PLANT COVER OF MORAINE REGIONS. Vostokova, T. A.; Tyuryukanova, E. B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1972. 16p. (In Russian). INIS.

The regularities in the distribution and migration of radioactive fission products in soil-plant cover of the Russian Plain were investigated. The study was carried out on the Valdaiskii stratum in the Novgorodskii area during 1967 and 1968. The content of ^{90}Sr and ^{137}Cs in moraine soils varies over wide limits. ^{90}Sr migrates with soil water, surface water, and ground water. ^{137}Cs moves with soil runoff. Secondary accumulation of ^{90}Sr takes place in the lower third of soil slopes occupied by mixed forests having a rich grassy plant cover. ^{137}Cs accumulates in alluvial stagnant soils. Mossy plant cover promotes the accumulation of ^{90}Sr and ^{137}Cs. In most soils the ^{90}Sr and ^{137}Cs are concentrated in the top surface layer of 30 cm. (SJR)

6525 (INIS-mf-1044) BEHAVIOR OF CESIUM-137 IN SODPODZOLIC SOILS OF THE UKRAINIAN ALLUVIAL PLAIN. Belova, E. I.; Sharonov, G. E.; Moiseev, A. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1972. 15p. (In Russian). INIS.

Results are presented of studies on the behavior of ^{137}Cs in turf-podzolic sandy soils of the Ukrainian Alluvial Plain (Polessie), and the transfer of ^{137}Cs into the plant cover and milk. It was established that an increased content of ^{137}Cs in pasture grass and milk at populated points of the Chernigovskii area of the Ukrainian Republic was due to the properties of the soils. The turf-podzolic sandy-loam and sandy soils of the Ukrainian Alluvial Plain because of its low absorptive capacity assures a relatively high transfer of ^{137}Cs along the food chain soil-plant cover-milk. (SJR)

6526 RADIOACTIVITY OF AIR FOUND IN SOILS. Ananyan, V. L.; Mnatsakanyan, B. G. (Inst. of Agrochemical Problems and Hydroponics, Erevan). Biol. Zh. Arm.; 26: No. 11, 66-69(Nov 1973). (In Russian).

The concentration of radioactive gases (emanation) in natural conditions in different types of soil in Armenia was studied. A sharp dependence of the emanation on the moisture of the soil was established. The emanating power of some Armenian soils was determined. (tr-auth)

6527 NUMERICAL METHOD OF CALCULATING THE DYNAMICS OF SORPTION OF A SUBSTANCE IN A MEDIUM WITH VARIABLE TRANSFER COEFFICIENTS. Prokhorov, V. M.; Ryzhinskii, M. V.; Margolin, A. M. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 302-306(1973).

Translated from Radiokhimiya; 15: No. 3, 298-304(1973).

A numerical method was developed for calculating the dynamics of the sorption of a substance on a sorbent with properties that vary with time and along the coordinate. A computer program written in Algol-60 language was produced for this method. A method was proposed and a program developed for calculating and predicting the vertical migration of ^{90}Sr in soil with properties which change with depth and time. The method gives results quite close to the results obtained using an analytical solution. (auth)

6528 PREOPERATIONAL LEVELS OF ENVIRONMENTAL RADIOACTIVITY IN WATER AND SEDIMENT AROUND TURKEY POINT NUCLEAR POWER PLANTS, CARD SOUND, FLORIDA. Johnson, T. S. (Univ. of Miami); Pemble, T. D. Radiat. Data Rep.; 15: No. 3, 117-123(Mar 1974).

An investigation of the levels and distribution of gross alpha, gross beta and selected gamma-emitting radioisotopes present in water and sediment samples from Card Sound, Fla. was performed. This environmental radioactivity baseline study was carried out between January 1971 and June 1972, prior to operation of the Turkey Point Nuclear Power Plants and discharge of liquid effluents from these plants into Card Sound. (auth)

Water

Refer also to abstracts 6479 and 7170.

6529 (AEC-tr-7512, pp 359-367) MOVEMENT OF RADIOSTRONTIUM WITH GROUND WATER CURRENT. Belitskii, A. S.; Orlova, E. I.; Ryzhov, A. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Field studies were conducted on the movement of ^{89}Sr and ^{90}Sr in an alluvial bench consisting of quartz sand. Strontium delivered into underground water was distributed in the direction of movement of underground water. Most of the Sr contained in ground water was sorbed by sand near the contamination site. Radioactive strontium absorbed by sand could reenter ground water as a result of desorption under the influence of changes in water chemistry. (HLW)

6530 (INIS-mf-38) NATURAL RADIOACTIVE ISOTOPES IN SEA FISH AND WATER. Teplykh, L. A.; Ramzaev, P. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 8p. (In Russian). INIS.

Information is presented on the concentrations of the most important natural isotopes in seawater and in ten kinds of commercial fish. On the basis of analyses of 20 samples of ocean water taken at 11 points of the open Atlantic Ocean it was established that the average concentration of ^{210}Pb in ocean water is equal to 0.2 picocuries/l; ^{226}Ra is 0.13 picocuries/l; and ^{40}K is 370 mg/l. Results are presented on the concentrations of ^{210}Pb, ^{210}Po, ^{40}K, ^{226}Ra and ^{228}Th in muscle and bone of commercial fishes. Doses from natural radioisotopes in fish tissues are given as calculated from the concentrations which were found and from the effective energies given in handbook MKRZ-59. It was established that ^{210}Po in fish is the main contributor to the dose. (SJR)

6531 (INIS-mf-887-3, pp 53-62) RADIOACTIVE CONTAMINATION OF WATERS: THE EFFECT OF RADIOACTIVE RAW MATERIAL EXPLOITATION AND PROCESSING. Mansfeld, A.; Hanslik, E. (Vyzkumny Ustav Vodohospodarsky, Prague). [nd]. (In Czech).

Data are briefly surveyed on the average radiochemical composition of waste waters discharged in the exploitation and processing of radioactive raw materials, on the factors affecting mine water composition, and on the effect of individual factors on the incidence of natural radionuclides in mine waters. Time averages of the chemical and activity composition of the waters are evaluated. Methods of decontamination and of radionuclide removal from the uranium industry waste waters are briefly described. Among natural radionuclides, attention is paid to radium and uranium; the results confirm that an increase may be expected in the radioactive mine water wastes. (INIS)

6532 (INIS-mf-887-3, pp 131-151) CONTAMINATION OF THE SVRATKA RIVER BASIN WITH WASTE WATERS FROM URANIUM INDUSTRY AND THE HAZARDS FOR A CRITICAL POPULATION GROUP. Skalicky, J.; Karasek, R. (Ustav Hygieny Prace v Uranovem Prumyslu, Pribram, Czech). [nd]. (In Czech).

Data are briefly given on the effect of the uranium industry plants in Moravia on the population living in the basin of the Svratka river to which mine waste waters are discharged. The significance of population exposure in dependence on natural conditions and on the ^{226}Ra dose is assessed. The average daily intake was calculated per individual of the critical population group of ^{226}Ra from water and foodstuffs. The calculated values of the ^{226}Ra deposition show that they attain approximately $1/_{10}$ of the permissible deposition per individual of the population provided the waste waters are decontaminated. (INIS)

6533 (INIS-mf-1041) DISTRIBUTION OF RADIOACTIVE ISOTOPES IN WATER RESERVOIRS. Khristianova, L. A.; Anikiev, V. V.; Vinogradova, N. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 20p. (In Russian). INIS.

On the basis of a complex of studies on the distribution of radioisotopes in water reservoirs, data were obtained which showed that: the distribution of fission product radioisotopes along components of the water reservoir obeys the same laws as found in impounded waters (no flow-through); the main source for entry of fission product radioisotopes is runoff water; and the dominant processes in the redistribution of radioisotopes between the water phase and bottom deposits are the diffusion of dissolved radioisotopes into the bottom deposits, and cementation of clay particles. Natural processes in the zone of hypergenesis cause secondary fractionation of radioisotopes not only in various components of the water reservoir, but also create a spatial distribution of this effect. The results can serve as a basis in solving various problems of radioecology and the geochemistry of hypergenesis. (SJR)

6534 (UCSD-34-P-84-X-8) COMPARATIVE MARINE GEOCHEMISTRIES OF LEAD-210 AND RADIUM-226. Bruland, K. W.; Koide, M.; Goldberg, E. D. (Scripps Institution of Oceanography,

La Jolla, Calif. (USA)). 1974. Contract AT(04-3)-34. 15p. Dep. NTIS $4.00.

The ^{226}Ra and ^{210}Pb concentrations in Gulf of California and Eastern Pacific seawaters appear to be governed by the extents of upwelling and by the consequential biological productivities. The residence times of ^{226}Ra and ^{210}Pb in the highly productive Gulf of California surface waters are calculated to be a few months and less than a month, respectively, on the basis of upwelling rates. (auth)

6535 DATA. Section II. Water. Radiat. Data Rep.; 15: No. 3, 129-131(Mar 1974).

Data from radiation monitoring during the period from July 1971 to July 1972 of raw and treated water supplies in Minnesota are presented. The samples were analyzed for gross beta and gross alpha radioactivities. The monthly averages of gross beta radioactivity in Minnesota raw surface waters ranged from 4 to 35 pCi/liter, which was well below public health drinking water standards. (LCL)

6536 GEOCHEMICAL BALANCE OF RADIOACTIVE ELEMENTS IN THE BASIN OF THE BLACK AND AZOV SEAS. III. Balance of Radium. Drozhzhin, V. M.; Nikolaev, D. S.; Lazarev, K. F.; Grashchenko, S. M. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 416-421(1973).

Translated from Radiokhimiya; 15: No. 3, 415-421(1973).

The radium concentration was determined in the water and suspension of the main rivers of the basin of the Black and Azov Seas. On the basis of the data obtained the main elements of the balance and the radium balance itself were calculated for the Black and Azov Seas. Analysis of the elements of the balance indicates a deficit of radium in the bottom deposits of the Black Sea, which may be explained by an error in the calculations or by its extraction from sea sediments. The residence times of radium in the waters of the Black and Azov Seas were calculated and found to be about 400 and 4 years, respectively. From the radium balance we calculated the rate of contemporary sediment accumulation for the Azov Sea and this was found to be 160 cm/1000 years. (auth)

6537 DISPOSAL OF LIQUID EFFLUENTS FROM THE CEN CADARACHE. Measures Taken to Avoid Environmental Pollution. Mery, J.; Roux, R. (CEN de Cadarache, Saint-Paul-les-Durance, France). pp 35-45 of Control of Ionizing Radiation: Pollution, Dosimetry, Applications. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress of the Health Physicists's Association; Marseilles, France (16 May 1972).

The Cadarache center consumes an extremely large quantity of water (3,000,000 m^3 per year). This water is used for industrial, domestic, and fire protection purposes. Most of this water is disposed in the Durance after use. Steps are taken to avoid pollution (separation of the different used water networks, treatment of waters contaminated in special installations). Controls were effected on the toxicity and radiotoxicity in the buildings producing the effluents and in the used water collectors. The radioactivity is continuously monitored at stations situated along the Durance and intermittently by systematic sampling. The equipment and control techniques adopted are described. (FR)

6538 $^{234}Th/^{238}U$ ACTIVITY RATIOS IN PACIFIC OCEAN BOTTOM WATERS. Amin, B. S.; Krishnaswami, S.; Somayajulu, B. L. K. (Tata Inst. of Fundamental Research, Bombay). Earth Planet. Sci. Lett.; 21: No. 4, 342-344(Mar 1974).

The $^{234}Th/^{238}U$ activity ratios in the near-bottom waters at a station in the South Pacific were measured. The activity ratios are close to the secular equilibrium value, ranging between 0.9 and 1.13 (±8%), suggesting that the rate of removal of ^{234}Th by bottom-water scavenging processes at this station is slow compared to its rate of radioactive decay. The mean $^{234}U/^{238}U$ activity ratios in these waters is 1.14 ± 0.02, the same as the reported values for the world oceans. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 6549, 7082, 7147, and 7176.

6539 (AEC-tr-7512, pp 349-358) RADIOSTRONTIUM AS A FACTOR IN ENVIRONMENTAL CONTAMINATION. Marei, A. N. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

A review of migration of radioactive strontium in the biosphere is presented. Some topics discussed are: increase in radioactive background due to nuclear weapons testing and radioactive wastes; increased contamination of soil, plants, water; increased gamma radiation of the earth's surface; quantity of radioactive strontium in earth's atmosphere from fallout; dissipation and concentration of long-lived radioactive contaminants; role of plant foods in transfer of strontium from soil to the human body; and radioactivity of fish in fresh water reservoirs containing ^{90}Sr. (HLW)

6540 (INIS-mf-35) RADIOACTIVITY OF THE ENVIRONMENT, FOOD PRODUCTS, AND MAN IN THE UKRAINE IN THE PERIOD FROM 1962-1969. Mukhin, I. E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 23p. (In Russian). INIS.

From extended observations on the radioactivity of the environment, food products, diets and also from the observed accumulation of ^{90}Sr and ^{137}Cs in man it was possible to collect a broad spectrum of information from which were deduced regularities in the migration of both radioisotopes along biological chains. A quantitative estimate of these regularities is given. From an analysis of the data on the degree of contamination of separate food products by ^{90}Sr and ^{137}Cs and also from a quantitative analysis of the food requirements with age and productive activity being taken into account, it was possible to establish that 75 to 80% of the daily intakes of both radioisotopes by the Ukrainian population could be accounted for by bread and milk. The accumulation of strontium-90 in the bones of the Ukrainian population was found to depend on the age and daily intake of radioisotope with the diet. From the quantitative estimates on the migration rates of ^{90}Sr and ^{137}Cs along the main biological chains as obtained by these studies it was possible to predict the content of both radioisotopes both in food products and in man. The predicted amounts for the content of ^{90}Sr and ^{137}Cs in food products did not differ from the actual values by more than 20 to 25%. (SJR)

6541 (INIS-mf-1034) CONCENTRATION OF STRONTIUM-90 IN FOOD PRODUCTS AND ITS ENTRY BY WAY OF FOOD INTO THE POPULATION OF GEORGIA AS A RESULT OF STRATOSPHERIC FALLOUT IN 1965-1969. Khazaradze, R. E.; Gorgoshidze, V. A.; Orbelidze, I. A.; Pakeliani, M. M.; Tevdoradze Ch. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 16p. (In Russian). INIS.

The results of a radiochemical determination of ^{90}Sr in food products of the population of the Georgian Socialist Republic in 1963-1969 are considered. More than 1100 radiochemical analyses were carried out in all. Samples were taken in control areas with the physical-geographical and economic features of the republic being taken into account as well as the type of food. Sample selection, treatment and analysis were carried out by generally accepted methods. Data are tabulated presenting the content of ^{90}Sr in local food products and the average contamination level of ^{90}Sr in basic food products used by the urban and rural population of the Georgian Republic. It was established that buildup of a strontium maximum in the rural food diet will take place more rapidly in view of the fact that the turnover time for local food products is shorter. In estimating the radiation situation it is necessary to start out with the radiation dose to the rural population. (SJR)

6542 (JUL-999-ST) SPREADING OF HARMFUL MATERIALS IN THE ATMOSPHERE AND ENVIRONMENTAL IMPACT. Part 2. Investigations on the Deposition of Elemental and Organic-Bound Iodine on Grass. Progress Report, July 1971-December 1972 in the Framework of the Contract No. SC 24-003-PSTD Research Project Supported by the EURATOM-CEA Association. Vogt, K. J.; Heinemann, K.; Matthes, W.; Polster, G.; Stoeppler, M.; Angeletti, L. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Strahlenschutz). Jul 1973. 81p. (In German). Dep. NTIS (US Sales Only) $7.25.

Experiments are described which studied the deposition of iodine on grass and clover in the Kernforschungsanlage, Juelich. The rates of deposition determined in the outdoor experiments with natural elemental iodine are discussed in the light of an empirical equation, which, in addition to considering the meteorological parameters and the mass coverage of the ground with vegetation (dry mass), also uses biological parameters such as the age of the grass and the period of growth as factors. The deposition of elemental iodine on clover was also investigated in one experiment. The measured rates of deposition are about twice as high as for grass corresponding to the same mass coverage and meteorological parameters. In a further experiment, a biological halflife of 8.0 ± 0.5 d was measured of iodine on grass. Contrary to this, within the accuracy of measurement, no desorption could be detected if the grass was cut off immediately after contamination, with experiments with radioiodine in a glove box. The ratio of the normed deposition rates of elemental iodine to methyl iodide was investigated under identical experimental conditions in the glove box. The quotient of the deposition rates is 80:1 in the tests. Other authors found a value between 100:1 and 1,000:1. (GE)

6543 TRITIUM CYCLING IN A LAKE ERIE MARSH ECOSYSTEM. Lehman, J. W. (Ohio State Univ., Columbus). pp 65-75 of Proceedings of the Sixteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1973).

From 16th conference on Great Lakes research; Huron, Ohio, USA (16 Apr 1973). See CONF-730445-.

Preliminary results of tritium (^3H) cycling in a Lake Erie marsh ecosystem are presented. The objective of the research was to determine if bioaccumulation and translocation of tritium occur in a marsh ecosystem. Air, water, water vapor, sediment cores and invertebrate samples were collected from a two-hectare study unit which had been treated with approximately 1 Ci of tritium. An exponential loss rate of tritium from the treated water was determined. Tritium loss by evaporation was determined to parallel the loss rate from the water. A possible tritium sink was indicated from the ^3H activities of the sediment cores. Invertebrate samples of two snail species (Viviparus malleatus and Lymnaea exilis) and glass shrimp (Palaemonetes sp.) were analyzed for tritium activity. In general the tritium uptake and loss paralleled the tritium activity in the water, though niche preferences affected these rates. No long-term bioaccumulation of tritium was indicated, but there was an indication of translocation of tritium through the food chain. Further research should indicate more definite trends. (auth)

6544 UTILIZATION OF THE MARINE BIOLOGICAL CHAIN FOR CONTROLLING THE TRANSFER OF HEAVY METAL ISOTOPES. Aubert, M. (CEN de Cadarache, Saint-Paul-les-Durance, France); Bittel, R.; Donnier, B.; Laumond, F.; Barelli, M.; Romeo, M. pp 9-17 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From seventh national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

A general method is presented for studying transfers of some heavy metals (from which radioisotopes are produced by activation) across the general pelagic chain, stable isotopes often accompanying the radionuclides in the liquid effluents. The experimental food chain involves the following stages: phytoplankton, zooplankton, fish, and a final terrestrial stage, the mouse. The following heavy metals were tested: zinc, chromium, lead, copper, and mercury, these metals being both linked and nonlinked to complexing organic compounds: sewer water, humic acid, aminated acid, EDTA, and detergents. The results are discussed and interpreted in terms of the relations between radioactive pollution, and chemical mineral pollution or organic pollution of marine media. (FR)

6545 DATA. Section I. Milk and Food. Radiat. Data Rep.; 15: No. 3, 125-128(Mar 1974).

The radionuclide concentrations in human diets were determined by sampling foods served to school children at 26 institutions across the US. Each sample represented the edible portion of the diet for a full week. Drinking water was not included. The results showed that the ^{90}Sr dietary intake averaged 7 pCi/d. The ^{137}Cs intake averaged 4 pCi/d. The ^{140}Ba, ^{131}I, and ^{89}Sr concentrations were below detectable limits. (LCL)

6546 POSSIBLE EFFECTS OF IONIZING RADIATION UPON MARINE LIFE AND SOME IMPLICATIONS OF POSTULATED ACCIDENTAL RELEASES OF RADIOACTIVITY. Moscati, A. F.; Erdmann, R. C. (Univ. of California, Los Angeles). Nucl. Technol.; 22: No. 2, 184-190(May 1974).

Ionizing radiation will have both somatic and genetic effects upon the exposed populations. Somatic changes, i.e., effects produced directly in the irradiated organism, will result in the death of the irradiated species by a variety of natural mechanisms. Genetic effects, however, are more subtle and may sometimes be viewed as beneficial; however, the benefits accruing to subsequent generations have yet to be demonstrated for marine species. Two models for predicting the impact of radioactivity in the food chain upon man are reviewed here: (a) the critical pathway concept, and (b) the specific activity approach. The specific activity method was used by Aten in 1961 to obtain estimates of the maximum permissible concentrations of biologically important radionuclides in seawater $(MPC)_s$. In an accident situation involving the release of radioactivity from a light-water power reactor to the ocean, the most important radionuclides on the basis of the type of radiations emitted, quantity produced, half-life, and biological significance are the fission products ^{90}Sr, ^{137}Cs, ^{239}Pu, and the activation products ^{65}Zn, ^{54}Fe, and ^{95}Zr. The specific activity approach as applied to three classes of accidental radioactive releases to the sea can be used to determine the sensitive nuclide for each release and to estimate the relative degree of seriousness of each release by calculating the volume of seawater needed to dilute each spill to the (MPC), of the critical nuclide. Estimates made for three types of accidental releases at sea yield the following data: primary coolant release: ^{137}Cs critical nuclide, 33-km^3 dilution volume needed for 10^4-Ci total release; shipping cask loss: ^{90}Sr critical nuclide, 66- $\times 10^2$-km^3 dilution volume needed for 10^7-Ci total release; and core inventory release (75%): ^{90}Sr critical nuclide, 10^5-km^3 dilution volume for 10^8-Ci total release. It was found that the 10^4-10^7-10^8 total release relation among accidents was not maintained in the dilution to $(MPC)_s$. (auth)

6547 ALPHA RADIOACTIVITY OF MARINE ORGANISMS. Cherry, R. D. (Univ. of Cape Town); Shannon, L. V. At. Energy Rev.; 12: No. 1, 3-45(1974).

The important role played by alpha-radioactive nuclides in the marine radiation environment is discussed, and the need for comprehensive and co-ordinated knowledge concerning the distribution of these nuclides in the oceans and in marine life is motivated. The core of the article contains detailed surveys of the alpha-emitting nuclides and their relevant nuclear properties, and of the present state of knowledge of the concentration and distribution of these nuclides in seawater, in marine organisms and in the organs thereof. The dominant contribution made by the natural fallout nuclide ^{210}Po to the alpha radioactivity of most marine organisms is stressed. Brief comments are made on experimental techniques, the biogeochemical balance problem and radiation dosimetric considerations. The article concludes with the authors' suggestions for future lines of research. (auth)

6548 POLONIUM-210 IN THE ENVIRONMENT AND IN THE HUMAN ORGANISM. Parfenov, Yu. D. (Inst. of Biophysics, Moscow). At. Energy Rev.; 12: No. 1, 75-143(1974).

Polonium-210 occurs widely in nature and is an important component of man's natural radiation background. The contribution of this isotope to the total equivalent dose of natural internal radiation of the individual human tissues comprises up to 30%. General conclusions are reached from the available data on the ^{210}Po content of the environment. Values are given for the ^{210}Po content of the air, precipitation, soil, drinking water, and the water of rivers and oceans. The routes and mechanisms by which ^{210}Po accumulates in plants and animals on land and in plankton and fish in the sea are discussed. The natural rate of intake of ^{210}Po by the human body from air breathed, drinking water, and food is estimated. Data are presented on the ^{210}Po content of the soft tissues and skeleton of man and on the levels of urinary and fecal excretion. The role of ^{210}Pb in the deposition of ^{210}Po in the human body is examined and the alpha radiation doses to human tissues from ^{210}Po are calculated. Particular attention has been paid to aspects of the migration of the isotope via the chain lichen-reindeer-man in northern areas and to intake as a result of smoking. A detailed discussion is given of the possibility of ^{210}Po intake in uranium mines, from the exhaust fumes of motor vehicles, and from seafood. (auth)

Radiometric Techniques

Refer also to abstracts 6500, 6592, 6765, 6768, and 6807.

6549 (COO-1358-13) [BIOACCUMULATION AND TRANSLOCATION OF ^{36}Cl DDT IN A MEADOW ECOSYSTEM]. Technical Progress Report. Peterle, T. J. (Ohio State Univ., Columbus (USA)). [nd]. Contract AT(11-1)-1358. 2p. Dep. NTIS $4.00.

Chlorine-36 was used as a tracer to study the translocation of DDT in a meadow ecosystem and retention time in animals. A biological model was developed for the migration of DDT residues from the soil to slugs (Deroceras), earthworms (Lumbricus), and shrews (Blarina). The uptake of DDT from soil by invertebrates was also studied. Data are presented for the content in slugs (Zonitoides and Deroceras), millipeds (Parajulus), and spiders (Hadrobunus and Odiellus) at various times following application as clay granules on the surface of the study area. (CH)

6550 (EUR/C-IS-192-73) USE OF TRACER TECHNIQUES FOR THE PROTECTION OF WORKING AMBIENCE AND IN THE CONTROL OF INDUSTRIAL WASTES. Girardi, F. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1973. 12p. (In Italian). INIS.

The use of tracer techniques in the evaluation of the suitability of a place as a site for industrial installation is emphasized; the study should be carried out on air, soil and water in order to assess not only the static but also the dynamic properties of these components of the environment. Tracer techniques can

also be advantageously employed in the planning of industrial plants. Finally, tracer techniques will certainly play an important role in the monitoring systems through which a clean industry can be kept under constant control. (INIS)

6551 (JUL-998-ST) SPREADING OF HARMFUL MATERIALS IN THE ATMOSPHERE AND ENVIRONMENTAL IMPACT. Part 1. Investigations of the Atmospheric Diffusion of Off-Gas Plumes. Progress Report, July 1971–December 1972 in the Framework of the Contract No. SC 24-003-PSTD Research Project Supported by the EURATOM–CEA Association. Vogt, K. J.; Geiss, H.; Nordsieck, H.; Polster, G.; Rohloff, F. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Strahlenschutz). Jul 1973. 135p. (In German). Dep. NTIS (US Sales Only) $9.75.

The diffusion of impurities in the atmosphere was investigated by tracer experiments with radioactive aerosols (^{64}Cu, ^{142}Pr and ^{166}Ho) over very rough ground. The progress in instrumentation, the experimental results and improved evaluation methods are described. The evaluations show that the standard deviation of the horizontal and vertical concentration distributions are considerably larger than the Pasquill values. Thus the concentration maxima in the air near the ground lie much closer to the source than is to be calculated from Pasquill's practical system. By measuring with Vector wind plumes, these results are also verified and correlations between the standard deviations of the concentration distributions and those of the wind fluctuations are shown. The connections for the linear approach as well as for the exponential equation on the dependence of source distance of the diffusion parameters are discussed. Finally the influence arising from taking the wind profile on the position of the maximum of the near to ground concentration into account is investigated. (GE)

6552 STEADY-STATE MODEL OF ISOTOPIC FRACTIONATION ACCOMPANYING NITROGEN TRANSFORMATIONS IN SOIL. Shearer, G.; Duffy, J.; Kohl, D. H.; Commoner, B. (Washington Univ., St. Louis). Soil Sci. Soc. Amer., Proc.; 38: No. 2, 315-322(1974).

A steady-state mathematical model of isotopic fractionation accompanying certain nitrogen transformations in soils is developed. The model takes into account ammonification, nitrification, and immobilization; and predicts that the $^{15}N/^{14}N$ ratios of nitrate and ammonium ion depend in part upon the ratio of the rates of immobilization and ammonification. The ratio of the rates of immobilization to nitrification under field conditions is unlikely to be the same as under the conditions of laboratory incubation experiments. Therefore, this prediction provides a possible explanation for differences observed between the $^{15}N/^{14}N$ ratio of nitrate extracted from soil cores and that of nitrate released during laboratory incubation of the same soils. The model described is amenable to experimental test. If verified, an expanded version of the model may be a useful aid in the study of nitrogen transformations in the field. (auth)

6553 MINERALIZATION OF CARBON AND NITROGEN IN SOIL AMENDED WITH CARBON-13 AND NITROGEN-15 LABELED PLANT MATERIAL. Broadbent, F. E.; Nakashima, T. (Univ. of California, Davis). Soil Sci. Soc. Amer., Proc.; 38: No. 2, 313-315(1974).

Doubly labeled barley (Hordeum vulgare L.) plants were grown in a closed chamber containing ^{13}C-enriched CO_2 and ^{15}N-enriched nutrient solution. Tops and roots were separated, ground, and added to Columbia fine sandy loam in fritted glass filter tubes. Soil samples were incubated with continuous flow aeration for 5 years. Evolved CO_2 was trapped for 22 weeks. Mineral nitrogen was leached from the samples at intervals throughout the 5-year period. After 5 years, only 12% of the carbon from tops and 16% of that from roots remained in soil, compared with 38% of the nitrogen in tops and 57% of the root nitrogen. Average annual losses of carbon from soil organic matter were 6.1-6.8%; annual turnover of nitrogen varied from 6.3 to 7.4%. Availability ratios for nitrogen decreased as a function of time from about 2.5 initially to 1.2 at the end of the incubation period. Unaccounted-for losses of nitrogen from barley tops and from soil organic matter were 15-17%, but only 2% from roots. (auth)

6554 COMPARISON OF ^{15}N-DEPLETED AND ^{15}N-ENRICHED FERTILIZERS AS TRACERS. Starr, J. L.; Broadbent, F. E.; Stout, P. R. Soil Sci. Soc. Amer., Proc.; 38: No. 2, 266-267 (1974).

$(^{14}NH_4)_2SO_4$ from which virtually all ^{15}N had been removed was compared as a tracer with $(NH_4)_2SO_4$ containing 8.95% ^{15}N excess in a plant uptake experiment using soil columns maintained at $\frac{1}{3}$ bar tension and conventional greenhouse pots. Uptake of fertilizer nitrogen in three cuttings of ryegrass (Lolium Perenne L.) was identical with the two fertilizers. Estimates of residual fertilizer N in the pots agreed less closely, owing to the high dilution factor. (auth)

6555 URANIUM AND LEAD GAIN OF DETRITAL ZIRCON STUDIED BY ISOTOPIC ANALYSES AND FISSION-TRACK MAPPING. Grauert, B. (Carnegie Institution of Washington, DC); Seitz, M. G.; Soptrajanova, G. Earth Planet. Sci. Lett.; 21: No. 4, 389-399(Mar 1974).

Besides Pb and U loss and mixing of crystals of different age, U gain is considered a possible cause of discordant U–Pb ages of zircons. However, whether U gain without new zircon growth occurs in nature had not been proven, so far. In order to test this possibility, two detrital zircon populations were studied for which the absence of later zircon overgrowth after deposition could be demonstrated. The samples were separated from a metaquartzite near a large pegmatite body and from metaquartzite inclusions found in the pegmatite (Martell Valley, Italian Alps). The distribution of neutron-induced fission tracks reveals distinct accumulation of U in the rims of more than 90% of the zircon grains of the inclusions (total U in the crystals: 540–850 ppm), whereas in the country rock only some of the grains show similar but weaker patterns (total U: 155–320 ppm). From the isotopic data and from additional U–Pb and Rb–Sr analyses of minerals and whole-rock samples of the pegmatite, the marginal accumulation and the higher concentration of U in the zircon grains of the inclusions are interpreted as the result of episodic U gain during the intrusion of the pegmatite and/or during a later metamorphism. From the concentration levels of common Pb, an addition of Pb—and possibly other elements—to the zircon grains is inferred. (auth)

6556 USE OF LATERAL NEUTRON-GAMMA LOGGING AND REPEATED NEUTRON-GAMMA LOGGING MEASUREMENTS TO DETERMINE THE POSITIONS OF WATER-PETROLEUM AND WATER-GAS INTERFACES AT THE VUKTYL DEPOSIT. Basin, Ya. N.; Berman, L. I.; Parfenov, P. T.; Savinkin, P. T. Razved. Geofiz.; No. 55, 167-170(1973). (In Russian).

Using carbonate materials from the Vuktyl deposits, a study was made of the use of a combination of lateral logging—neutron-gamma logging and repeated neutron-gamma measurements for determining the location of water-petroleum interfaces and gas-water interfaces. Determination of the water-petroleum interface by the lateral logging—neutron-gamma logging combination is recommended only for collectors with granular porosity. The gas-water interface may be separated, according to the neutron-gamma logging data from filled-in uncased, and then in the cased boreholes about a year later after settling. Examples are given of the use of recommended methods. (tr-auth)

6557 METODICHESKIE REKOMENDATSII PO PRIMENENIYU YADERNOGEOFIZICHESKIKH METODOV KAROTAZHA NA MESTOROZHDENIYAKH BOKSITOV. (Procedural Recommendations on the Use of Nuclear Geophysical Methods in Surveying for Bauxite Deposits). Ilyumentsev, A. M.; Fel'dman, I. L; Yakubson, K. I.; Senko-Bulatnyi, I. N. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). 45p.

In the procedural recommendations consideration is given to the main proposal for the use of nuclear geophysical methods of prospecting for bauxite deposits, particulars of the method and technique of measurement, and problems of using multiple different methods of prospecting by radioactive surveying (gamma, neutron activation, neutron, etc.) in solving problems of finding and estimating bauxite minerals in well sections. Procedural directions were composed mainly from materials from VNII of nuclear geophysics and geochemistry of the USSR Ministry of geology, the Moscow Institute of the petrochemical and gas industry, and the Institute of geophysics of the Ural Science Center, Academy of Sciences, USSR. (SJR)

6558 PULSED-NEUTRON LOGGING WITH COMPENSATION FOR THE EFFECT OF HYDROGEN IN THE BED. Resvanov, R. A. (All-Union Scientific-Research Inst. for Nuclear Geophysics and Geochemistry, Moscow). pp 125-138 of Nuclear Geophysical and Geoacoustical Logging of Cased Boreholes in Additional Exploration of Oil and Natural-Gas Deposits. Moscow; Vsesoyuznii Nauchno-Issledovatel'skii. Yaderno Goefizikii i Geokhimii (1973). (In Russian)

A modification of the pulsed-neutron method of studying boreholes is proposed, based on the high sensitivity to the presence in the rock of chlorine and other elements with high neutron-absorption cross-section and low sensitivity to changes in the hydrogen content (porosity) of the rock. An approximate formula was obtained for selecting measurement regimes that would compensate the effect of the hydrogen content. (tr-auth)

6559 EFFECT OF SALINATION OF CEMENT RING AND STRATUM WATER ON RESULTS OF PULSED-NEUTRON LOGGING. Lebedev, V. E.; Petrosyan, L. G.; Srebrodol'skii, D. M. (All-Union Scientific-Research Inst. for Nuclear Geophysics and Geochemistry, Moscow). pp 87-108 of Nuclear Geophysical and Geoacoustical Logging of Cased Boreholes in Additional Exploration of Oil and Natural-Gas Deposits. Moscow; Vsesoyuznii Nauchno-Issledovatel'skii Inst. Yaderno Goefizikii i Geokhimii (1973). (In Russian)

Theoretical studies were made on the effect of changes in mineralization of cemented rocks and the surrounding zone on secondary pulsed neutron—neutron logging measurements. The problem was solved by a complex of numerical methods using a computer. Retardation of neutrons from $E_0 = 14$ MeV to $E_k = 0.1$ eV was calculated by a statistical testing method, nonstationary diffusion of neutrons from $t^\circ \approx 0$ to $t_k = 4$ msec by infinite-difference approximations. The model of the medium was a borehole-cement ring-sandstone layer with different porosities. The relation between changes in the pulsed-neutron logging and the degree of mineralization of the cemented rock and the surrounding zone was obtained. The results indicated the effectiveness of repeated pulsed-neutron studies, especially in old boreholes where, during lengthy exploration, there was regression of the cemented rock and breakup of the penetration zones. (tr-auth)

6560 NUCLEAR-GEOPHYSICAL TECHNIQUES FOR LOCATING NON-EXHAUSTED AND NEGLECTED PRODUCTIVE ROCKS. Konoplev, Yu. V.; Kitsenko, O. A.; Detkova, N. V. (All-Union Scientific-Research Inst. for Nuclear Geophysics and Geochemistry, Moscow). pp 194-203 of Nuclear Geophysical and Geoacoustical Logging of Cased Boreholes in Additional Exploration of Oil and Natural-Gas Deposits. Moscow; Vsesoyuznii Nauchno-Issledovatel'skii Inst. Yaderno Goefizikii i Geokhimii (1973). (In Russian)

A method is described for using various geophysical techniques to identify overlooked oil and gas strata, determine non-exhausted deposits in boreholes, and evaluate the degree of their saturation. Examples are given of the use of these techniques, in particular, of pulsed neutron logging of the gas-bearing strata of the Leningrad deposits which assay 250 thousand m^3/d, indicated to be water-bearing by lateral logging. (tr-auth)

6561 REPEATED NEUTRON-GAMMA LOGGING FOR LOCATING GAS DEPOSITS IN WESTERN UZBEKISTAN UPPER-JURASSIC CARBONATE STRATA. Grudkin, K. A. (All-Union Scientific-Research Inst. for Nuclear Geophysics and Geochemistry, Moscow). pp 223-229 of Nuclear Geophysical and Geoacoustical Logging of Cased Boreholes in Additional Exploration of Oil and Natural-Gas Deposits. Moscow; Vsesoyuznii Nauchno-Issledovatel'skii Inst. Yaderno Goefizikii i Geokhimii (1973). (In Russian)

A method is given for locating gas-bearing strata by repeated neutron-gamma logging after cementation of boreholes. An example is given of the practical application of the method in detecting productive deposits in the carbonate strata of western Uzbekistan. (tr-auth)

6562 EXPERIMENTAL RESULTS WITH TWO-PROBE MODIFICATION OF PULSED NEUTRON-NEUTRON LOGGING AT THE KRASNODARSK FIELDS PETROLEUM DEPOSITS. Moiseev, V. N.; Varvarskii, E. V. (All-Union Scientific-Research Inst. for Nuclear Geophysics and Geochemistry, Moscow). pp 204-216 of Nuclear Geophysical and Geoacoustical Logging of Cased Boreholes in Additional Exploration of Oil and Natural-gas Deposits. Moscow; Vsesoyuznii Nauchno-Issledovatel'skii Inst. Yaderno Goefizikii i Geokhimii (1973). (In Russian)

Information on electrometric, standard radiometric, one-probe, and two-probe pulsed methods, obtained in studies in two Krasnodarsk boreholes, was compared. The two-probe method of pulsed neutron-neutron logging was found to be more informative than other methods in determining the limits of fluoride sections and the homogeneity of the strata in cases when the coefficients of porosity and saturation can be determined from neutron parameters. (tr-auth)

6563 DIFFERENCE TECHNIQUES FOR DIRECT SOLUTION OF NEUTRON-MEASUREMENT PROBLEMS IN CASED BOREHOLES AND HETEROGENEOUS BEDS. Polyachenko, A. L. (All-Union Scientific-Research Inst. for Nuclear Geophysics and Geochemistry, Moscow). pp 65-86 of Nuclear Geophysical and Geoacoustical Logging of Cased Boreholes in Additional Exploration of Oil and Natural-Gas Deposits. Moscow; Vsesoyuznii Nauchno-Issledovatel'skii Inst. Yaderno Goefizikii i Geokhimii (1973). (In Russian)

Results are presented of the development of a multi-group finite-difference calculation apparatus for nuclear geophysics, made in a series of two-dimensional computer programs, RUM. Programs are given for direct quantitative solution of problems of various logging methods, and their modifications, that use neutron sources. The construction of boreholes and stratified layers are considered along with special features of the interaction of particles with substances. The following questions are considered: setting up the problem, geometry, physical description, calculational algorithms, limits, results of sampling, and prospect future possibilities for use of the RUM program. (tr-auth)

6564 WORK OF THE RADIOCARBON LABORATORY OF THE ALL-UNION RESEARCH INSTITUTE OF MARINE GEOLOGY AND GEOPHYSICS (RIGA) ON THE RELIABILITY OF MEASUREMENTS OF NATURAL RADIOCARBON ACTIVITY. Veksler, V.; Savvaitov, A.; Stelle, V. Izv. Akad. Nauk Est. SSR, Khim. Geol.; 23: No. 1, 80-82(1974). (In Russian).

Methods are presented for studying, with increased confidence level, the radiocarbon dating of samples. (tr-auth)

6565 ISOTOPIC-GEOCHEMICAL METHODS FOR STUDYING QUATERNARY DEPOSITS IN THE BALTIC AND BYELORUSSIAN REGIONS. Punning, Ya. M. (Inst. of Geology, Tallin, USSR). Izv. Akad. Nauk Est. SSR, Khim. Geol.; 23: No. 1, 83-85(1974). (In Russian).

The use of isotopic-geochemical methods (chiefly radiocarbon methods) for studying new deposits in the Baltic and Byelorussian regions is surveyed. In recent years it has been established that one of the chief assumptions of the radiocarbon method, the constant generation of ^{14}C, is correct only to a first approximation. This factor must be considered in precise geochronological studies. (tr-auth)

Site Surveys

Refer also to abstracts 5955, 8627, 8653, 8967-8969, and 8972.

6566 (CONF-740703-1) INTERACTIVE MODELING OF ECOSYSTEMS. Rust, B. W.; Mankin, J. B. (Oak Ridge National Lab., Tenn. (USA)). 1974. 27p. Dep. NTIS $4.50.

From computer simulation conference; Houston, Texas, USA (9 Jul 1974).

A computer program, MAIN, is presented which was developed to allow an ecologist with minimal experience in either mathematics or computers to develop an ecosystem model. The program provides the user with a flexible, interactive mode for solving simulation models. The program is written in FORTRAN for the DEC PDP-10 and can be modified for other terminal systems. As many as 100 parameters can be varied interactively by the user. An example illustrating the use of the program is included. (LCL)

6567 (DOCKET-701327-3) URANIUM HEXAFLUORIDE FACILITY. Draft Environmental Statement. (Allied-General Nuclear Services, Barnwell, S. C. (USA)). 30 Jun 1972. 107p. Dep. NTIS $8.50.

The environmental effects of the construction and operation of a Uranium Hexafluoride Facility at the Barnwell Nuclear Fuel Plant site in South Carolina are examined. Information is included on: the environment in the area including the history, geology, geography, demography, hydrology, ecology, and land use; the facility and its effluents; impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable commitments of resources, and cost-benefits analysis of the environmental effects. (LCL)

6568 (NP-19964) SEMINAR ON THE ENGINEERING ASPECTS OF SITING AND OPERATING POWER PLANTS, FEBRUARY 13-14, 1973, WASHINGTON, D. C. (Atomic Industrial Forum, Inc., New York (USA)). 1973. 310p.

Fifteen papers were presented. A separate abstract was prepared for each of 14 papers. One paper appeared previously in NSA as abstract No. 28: 29238. (LCL)

For abstracts of individual papers see: 6193, 6478, 6569-6572, 6575-6578, 8627, 8653, 8701, and 8918.

6569 (NP-19964, pp vp, Paper 8) OPENING REMARKS FOR PANEL DISCUSSION ON POWER PLANT SITING. Watson, J. E. (Tennessee Valley Authority, Chattanooga). 1973.

In seminar on the engineering aspects of siting and operating power plants.

The various factors which must be considered in selecting a power plant site are reviewed, and the development of a legislative process of site review and resolution involving a single agency made up of competent experts is recommended. (LCL)

6570 (NP-19964, pp vp, Paper 10) SITING ON RIVERS AND ESTUARIES. Bartnoff, S. (New Jersey Power and Light Co., Morristown). 1973.

In seminar on the engineering aspects of siting and operating power plants.

Some of the key environmental site characteristics which should be examined in locating fossil-fuel and nuclear power plant sites on rivers and estuaries are described. It is emphasized that power plants can be designed, constructed, and operated on sites adjacent to many rivers and estuaries through appropriate consideration of probable types of environmental impact, through proper plant design, and through recognition of all the benefits and costs associated with construction and operation. It is recommended regulations protecting and restoring the water quality in our rivers and estuaries be applied to all municipalities and all industries, not only the electric power industry, who use these waters. (LCL)

6571 (NP-19964, pp vp, Paper 11) POWER PLANT SITING ON LAKES. Burstein, S. (Wisconsin Electric Power Co., Milwaukee). 1973.

In seminar on the engineering aspects of siting and operating power plants.

The problems, advantages, and opportunities related to power plant siting on lakes are discussed. Information is included on water quality, water uses, demographic characteristics of lakes, meteorological conditions, advantages of lakes for once-through cooling systems, costs, and effects of power plant effluents on lake shore environments and ecosystems. (LCL)

6572 (NP-19964, pp vp, Paper 13) ENVIRONMENTAL PLANNING PROCESS FOR TRANSMISSION LINE ROUTING. Stern, P. M. (Northeast Utilities, Hartford). 1973.

In seminar on the engineering aspects of siting and operating power plants.

Over the past four years the Northeast Utilities environmental planning staff has gradually developed a procedure which formally introduces a variety of environmental considerations and reviews into the transmission line planning process. Justification of the need for a line and demonstration that the preferred route has the least possible adverse environmental impact is required under Connecticut Public Law 575. The environmental planning process described herein is carried out and documented in every application filed with the Power Facility Evaluation Council. (auth)

6573 PROCEEDINGS OF THE SIXTEENTH CONFERENCE ON GREAT LAKES RESEARCH, HURON, OHIO, APRIL 16–18, 1973. Ann Arbor, MI; International Association for Great Lakes Research (1973). 1078p. (CONF-730445-).

Fifty-six papers were presented. Separate abstracts were prepared for four papers. The remaining 52 papers on physical, chemical, meteorological, and biological conditions of the Great Lake waters and geological, meteorological, and hydrological conditions of the adjacent area were not within the subject scope of NSA. (LCL)

For abstracts of individual papers see: 6543, 6581, 6582, and 6591.

Thermal Effluents

Refer also to abstracts 6550, 6568, 6593, 6594, 8694, 8804, 8810, and 8967–8969.

6574 (EPA-440-1-74-15) DEVELOPMENT DOCUMENT FOR PROPOSED BEST TECHNOLOGY AVAILABLE FOR MINIMIZING ADVERSE ENVIRONMENTAL IMPACT OF COOLING WATER INTAKE STRUCTURES. (Environmental Protection Agency, Washington, D. C. (USA)). Dec 1973. 184p.

Adverse environmental impacts that could occur from cooling water intakes refer to the net damage or destruction of aquatic organisms by external interaction with the industrial cooling system. Factors which influence the adverse environmental impact are the intake volume, quantity and types of organisms involved, characteristics of intake structure and the cooling system, and chemicals added to the cooling system for biological control. Recommended technologies to be considered for minimizing adverse environmental impacts at any specific cooling system site are discussed by considering the site characteristics, the design, construction, operation and maintenance of the intake structure, methods for diverting fish from the water intake, and cost data. (LCL)

6575 (NP-19964, pp vp, Paper 3) COOLING SYSTEM OPTIONS FOR POWER PLANTS. Hamann, J. R. (Detroit Edison Co., MI). 1973.

In seminar on the engineering aspects of siting and operating power plants.

The alternatives to and the costs of changing traditionally used once-through cooling systems to other cooling systems for in power plants in Michigan are discussed. The need for obtaining quantitative data on the effects of thermal effluents on aquatic life in the Great Lakes is emphasized. (LCL)

6576 (NP-19964, pp vp, Paper 4) COOLING SYSTEM OPTIONS FOR POWER PLANTS. The Case for Once-Through Cooling. Boyer, V. S.; Wiedersum, G. C. (Philadelphia Electric Co., PA). 1973.

In seminar on the engineering aspects of siting and operating power plants.

The design and operation of once-through cooling water systems for power plants, particularly nuclear power plants, are described. The effects of such cooling systems on the body of water supplying and receiving the cooling water are discussed. The biological effects on fish of the heat and cleaning chemicals discharged from the cooling systems are mentioned. It is concluded that, for the very large amounts of heat that must be discharged from a power plant, a once-through cooling system is the preferable choice in many cases because it has the lowest cost, it requires the least space, it has little or no influence on aesthetics or the atmosphere, and it results in less net loss of water, compared to alternatives such as cooling towers or spray ponds. Careful design of intake and discharge structures and competent investigation of marine life in the vicinity can result in a minimum overall effect on the environment and a very favorable benefit-cost ratio. (LCL)

6577 (NP-19964, pp vp, Paper 5) COOLING TOWERS: STATE OF THE ART. Kolflat, T. D. (Sargent and Lundy Engineers, Chicago). 1973.

In seminar on the engineering aspects of siting and operating power plants.

Cooling towers offer a viable and economic means for the necessary dissipation to the environment of waste heat discharged from power plants. Cooling towers are discussed in terms of: theory of operation; design types including mechanical draft, natural draft, wet-dry, and dry-type; market demand; cost and power requirements; and optimization of the overall cooling system design. (LCL)

6578 (NP-19964, pp vp, Paper 6) PRESENTATION ON COOLING LAKES AND CANALS. Gardner, R. J. (Florida Power and Light Co.). 1973.

In seminar on the engineering aspects of siting and operating power plants.

Cooling method for power plants involving cooling lakes, canals, ponds, or reservoirs are discussed in terms of the mechanisms of heat transfer involved, design configurations, components used in these cooling systems, environmental effects, costs, and the advantages of these systems as compared with other power plant cooling systems. (LCL)

6579 (ORNL-tr-2773) DISTRIBUTION OF THE ZOOBENTHOS IN THE WATER RESERVOIR-COOLER OF THE LITHUANIAN POWER PLANT. Rachunas, L. A. Translated from Biol. Vnutr. Vod, Inform. Byull.; No. 10, 12-18(1971). 5p. Dep. NTIS $4.00.

Results are reported from a study of the zoobenthos of the water reservoir-cooler of the Lithuanian power station. Interest was centered on the distribution of the numbers and the biomass of the separate species of different groups of bottom-dwelling animals in the region affected by the current of hot water and beyond its limits. (auth)

6580 (ORNL-tr-2774) PECULIARITIES OF VERTICAL DISTRIBUTION OF TEMPERATURE IN THE WATER IN THE ZONE AFFECTED BY THE KONAKOVSK POWER STATION. Butorin, N. V. Translated by Martha Gerrard from Biol. Vnutr. Vod, Inform. Byull.; No. 10, 66-71(1971). 4p. Dep. NTIS $4.00.

Special features of the vertical distribution of temperature in the water reservoir that receives heated effluents from the Konakovsk power plant are discussed, and data from temperature measurements made during May 9 to 14, 1968 are presented. (LCL)

6581 POWER PLANT THERMAL EFFLUENTS IN SOUTHEASTERN LAKE ONTARIO. Chermack, E. E.; Galletta, T. A. (State University Coll., Oswego, NY). pp 663-674 of Proceedings of the Sixteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1973).

From 16th conference on Great Lakes research; Huron, Ohio, USA (16 Apr 1973). See CONF-730445-.

Analyses of data taken by an airborne infrared thermometer over the past two years are presented. The geographical region of coverage includes power plant sites along Lake Ontario's south shore from west of Rochester to the Mexico Bay area in New York. This area is currently being developed to become a major power generation corridor in the next ten years. Data include detailed surface thermal structure in the immediate vicinity of four power plant outfalls as well as thermal structure of large areas of the lake adjacent to and lakeward of the outfalls in order to provide baseline data. Attempts to obtain data in all seasons have been made and this collection thus contains data from every month of the year. Particularly, analysis has centered on the size, shape and behavior of the effluent pools under varying wind, lake current and seasonal conditions plus the ambient or background thermal field. The data were interpreted in the light of the current New York State guidelines for thermal effluents. Preliminary results indicate the need for further elaboration or revision of these guidelines, if they are to be applied to large lakes. (auth)

6582 TEMPERATURE AND VELOCITY MEASUREMENTS IN THE NEAR-FIELD REGION OF THERMAL PLUMES. Frigo, A. A.; Frye, D. E.; Siebold, P. (Argonne National Lab., IL). W-31-109-ENG-38. pp 684-701 of Proceedings of the Sixteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1973).

From 16th conference on Great Lakes research; Huron, Ohio, USA (16 Apr 1973). See CONF-730445-.

Field measurements of the near-field temperature and velocity distributions were made near the outfalls of the Point Beach and the Palisades Nuclear Power Plants on Lake Michigan late in 1971 and during the 1972 field year. A two- or three-point mooring system was used to hold a small boat steady, while obtaining simultaneous temperature and velocity measurements. Station locations of the boat were determined using surveyors' transits or a radar range-positioning system. A direct reading current meter with an affixed thermistor was used to measure current velocity and water temperature. Measurements were made as a function of depth at each station location. In addition, a technique has been developed for studying the time-temperature history experienced by a drogue drifting in a thermal discharge. This drogue may be considered analogous to an organism drifting in the discharge. Measurements were made at the Point Beach Nuclear Power Plant using a cruciform-style drogue with an attached instrument package consisting of a strip-chart recorder, thermistor and battery pack. The trajectory of the drogue was determined using surveyors' transits. This experiment demonstrated that a simple inexpensive method can be utilized to measure the time-temperature history of an organism drifting in a thermal plume. (auth)

6583 PROBLEME DES INDUSTRIELLEN KUEHLWASSERS. (Problems on Industrial Cooling Water. Conference Held at Essen, Germany, February 21, 1972). Giessen, K. (ed.) Haus der technik-vortragsveroeffentlichungen, Heft 289. Essen; Vulkan-Verlag Dr. W. Classen (1972). 54p. (CONF-720235-).

The eight papers presented at the conference on the relation between power plants and the environment, and specifically the problems presented by industrial needs for cooling water, are compiled together with the comments and discussions of the participants. The topics discussed are the present situation with respect to cooling water in the German Federal Republic, the numerical simulation of heat exchange processes in water using the heat load plan of the Rhine as an example, problems of industrial cooling water, economic aspects of various cooling methods, possibility of providing additional water for cooling towers from canals, cloud and ice formation in cooling tower operation, accumulation and release of dissolved and undissolved material during cooling tower operation, and noise problems in large recooling installations. (JSR)

6584 COOLING PROBLEMS IN THERMALLY POLLUTED RECIPIENTS. Milanov, T. (Sveriges Meteorologiska och Hydrologiska Inst., Stockholm). Nord. Hydrol.; 4: No. 4, 237-255(1973).

The extension of the warm water plume in receiving waters used as recipients for thermal effluents has been studied using a meteorological approach. For some real cases the area of excess temperature has been examined and compared to the conditions when heat is transferred to the atmosphere only. Numerical values are given for the warm water areas for different localities in Sweden for cooling water discharge corresponding to 2000 MW waste heat. (auth)

6585 PROBLEMS ON COOLING WATER DISCHARGE FROM NUCLEAR POWER STATIONS. Wada, A. (Central Research Inst. of Electric Power Industry, Tokyo). Nippon Genshiryoku Gakkaishi; 15: No. 6, 386-396(Jun 1973). (In Japanese).

A nuclear power station requires about 50% more cooling water than a thermal power station. Cooling water discharged to sea with its temperature raised by the heat exchange in condenser, results in the temperature rise of seawater of from 5 to 7°C on the average. In the Water Pollution Control Law of Japan, the temperature rise of water is regarded as an object to be controlled, being one of water quality degradation phenomena. However, there are some problems on setting the criteria for dischargeable water. Of these, the diffusion problem is described. In studies of the diffusion characteristics of seawater in Japanese coastal area, two types of diffusion have been recognized after long term observation and analysis. Examples of the methods and results of observations in Anegasaki thermal and Mihama nuclear power stations on the diffusion of warm drain water are given. In either case, temperature distribution patterns in seawater agreed well for measurements both on board ships and from airplanes with infra-red imaging devices. It is no exaggeration to say that a systematic approach has not been carried out regarding the examination and study on the objective data, analytical techniques, and the effect of warm water discharge on aquatic lives, as required for determining safe practices for cooling water discharge. Therefore, many problems related to the discharge of cooling water remain unsolved. (JA)

6586 FOG AND DRIFT DEPOSITION FROM EVAPORATIVE COOLING TOWERS. Hanna, S. R. (National Oceanic and Atmospheric Administration, Oak Ridge, TN). Nucl. Safety; 15: No. 2, 190-196(1974).

Methods of determining fog and drift deposition due to emissions from evaporative cooling towers are reviewed and formulas suggested that can be used as a basis for calculations. The Gaussian plume formula is recommended for calculating fog concentrations from which visibility can be estimated. For drift droplets with diameters greater than 200 μm, deposition is calculated by ballistics methods, knowing the environmental wind speed and relative humidity and the vertical velocity of the plume and the droplet. Evaporation of the droplets is accounted for. Drift droplets with diameters less than 200 μm are assumed to be dispersed according to the Gaussian plume formula, with the plume tilted downward to account for the settling speed of the droplet. (auth)

6587 EVALUATING WATER SURFACE HEAT EXCHANGE COEFFICIENTS. Hindley, P. D.; Miner, R. M. J. Hydraul. Div., Amer. Soc. Civil Eng.; 98: No. HY 8, 1411-1426(Aug 1972).

Simulation of a power plant thermal discharge on a hydraulic model inside an enclosed building requires adjustment of the heat exchange coefficients at the water surface in order to account for physical differences in ambient conditions. The experimental method is based on a first-order treatment of well-stirred pools, with local linearization. Results are compared against empirical predictive equations of D. K. Brady, W. L. Graves, and J. C. Geyer ["Surface heat exchange at power plant cooling lakes," Publication No. 69-901, Edison Electric Institute, New York, Nov. 1969] which require meteorological input. Results of these valiant attempts to attack this multiparameter problem cannot be widely accepted for application. They remain dubious until generalized within the theoretical framework of similitude. (Appl. Mech. Rev.)

6588 WINTER-REGIME THERMAL RESPONSE OF HEATED STREAMS. Paily, P. P.; Macagno, E. O.; Kennedy, J. F. (Univ. of Iowa, Iowa City). J. Hydraul. Div., Amer. Soc. Civil Eng.; 100: No. HY4, 531-551(Apr 1974).

The increase in water temperature in natural streams due to waste heat disposal from thermal power plants leads to extensive ice-free reaches during winter periods. It is shown that the surface heat exchange between water and the atmosphere can be expressed, for most practical purposes, as a linear function of the water temperature. Using this approximation, a closed-form solution of the one-dimensional unsteady convection-diffusion equation is developed to predict temperature distributions in streams and the lengths of ice-free reaches downstream from the thermal discharge sections. (auth)

Chemical Effluents

Refer also to abstracts 5900, 6044, 6550, 6780, 6788, 8942, and 8967–8969.

6589 (EPA-450-2-74-4) STATE AIR POLLUTION IMPLEMENTATION PLAN PROGRESS REPORT, JUNE 30–DE-

CEMBER 31, 1973. (Environmental Protection Agency, Research Triangle Park, N. C. (USA); Environmental Protection Agency, Washington, D. C. (USA)). Apr 1974. 119p. NTIS.

Plans for attainment of national ambient air quality standards have been submitted by all States. Progress toward implementing those plans from June 30 to December 31, 1973 are presented. Presently, 16 State Implementation Plans (SIPs) have been fully approved by EPA, discounting disapprovals with respect to maintenance of national standards. Of the other 39 plans, 26 have only regulatory deficiencies, which have been corrected by EPA promulgation, and 13 are being finalized. Extensions for attaining primary standards and for developing plans for attaining secondary standards have been granted, and the status of these extensions is discussed. The status of Federal assistance to States in implementation of SIPs and State and local resource requirements for SIP implementation are examined. National issues affecting the SIPs are discussed. The adequacy of air monitoring networks and air quality data reporting is reviewed. Efforts are needed to improve the distribution and quantity of monitors and to assure timely data reporting. EPA's Plan Revision Management System is discussed. The System, which identifies "possible deficiencies" in the attainment of air quality standards, has been extended to cover 67 Air Quality Control Regions. Deficiencies identified are being investigated by the Regional Offices. The status of EPA enforcement activities is also presented. Compliance schedules are being developed for all major sources, and these schedules are being monitored and enforced. (auth)

6590 (Y-1934) DISPOSAL OF OIL WASTES BY MICROBIAL ASSIMILATION. Francke, H. C.; Clark, F. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 16 May 1974. Contract W-7405-eng-26. 45p. Dep. NTIS $4.00.

A biological assimilatory process for the disposal of plant oil waste products has been successfully demonstrated. The process involves mixing waste petroleum products into soil where naturally occurring microbial assimilation results in destruction of the oily wastes. Disposal of waste oil and machine coolants was evaluated in laboratory tests and on six experimental field test plots comprising approximately one acre of land at the Oak Ridge Y-12 Plant. Approximately 15,000 gal (56.7 m^3) of waste oil and 51,000 gal (193 m^3) of machine coolant were spread on the cultivated and fertilized experimental plots over a four-month test period. Fertilizer and organic carbon losses on the test plots were minimal in rainwater surface runoff, in soil percolate water, and by evaporation. Disposal rates were greater than 1.5 lb of oil per ft^3 of soil per month (24 kg/m^3 per month) and 4.45 lb of coolant per ft^3 of soil per month (71 kg/m^3 per month). (auth)

6591 SULFUR ISOTOPE ABUNDANCES IN GREAT LAKES WATERS; A PRELIMINARY REPORT. Nriagu, J. O. (Canada Centre for Inland Waters, Burlington, Ont.). pp 1038-1043 of Proceedings of the Sixteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1973).

From 16th conference on Great Lakes research; Huron, Ohio, USA (16 Apr 1973). See CONF-730445-.

A general survey of the sulfur isotopic composition of dissolved sulfates in Lakes Michigan, Huron, Erie and Ontario has been made. Unlike Lake Erie, where S^{34}/S^{32} ratios show regional and temporal variations, the other lakes are homogeneous with respect to their sulfur isotopic compositions. The mean δS^{34} values are: Lake Michigan +4.6‰, Lake Huron +6.3‰, Lake Erie (Western Basin) +6.4‰, Lake Erie (Central and Eastern Basins) +5.2‰ and Lake Ontario +5.9‰. The δS^{34} data do not correlate with the sulfate concentrations in these lakes, which show a progressive enrichment from Lake Michigan to Lake Ontario. (auth)

6592 APPLICATION OF NUCLEAR TECHNIQUES TO THE MEASUREMENT AND CONTROL OF ATMOSPHERIC POLLUTION. Rzekiecki, R. (CEN de Cadarache, Saint-Paul-les-Durance, France). pp 53-57 of Control of Ionizing Radiation: Pollution, Dosimetry, Applications. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress of the Health Physicists's Association; Marseilles, France (16 May 1972).

The advantages brought to industrial atmospheric pollution studies by the introduction of nuclear techniques are reviewed. High resolution analysis (x-ray fluorescence, electron capture, mass spectrometry, and neutron activation) allowed gaseous pollutants and dusts to be identified and their concentration levels to be measured. The use of tracers (radioactive, stable, and activable) together with the appropriate tracer techniques enabled transfer coefficients to be measured in the atmosphere at a given site. The work effected by the S.E.S.R. at Cadarache on activation analysis and the use of tracers is presented. (FR)

6593 FRESH WATER POLLUTION. III. Problems and Control. New York; MSS Information Corporation (1973). 220p. $15.00.

Water pollution control is discussed in relation to prevention and monitoring techniques, enforcement, managing aquatic life systems, and effluent quality control. Waste treatment processes used in the meat packing, leather tannery, textile, and oil industries are examined. These processes include film-flow reactors, polyelectrolytes, activated C, rotating disks, and ultra-high-rate filtration. The ecological management problems and biological effects of thermal discharges are discussed. (Pollut. Abstr.)

6594 NEW FEDERAL WATER POLLUTION CONTROL ACT AND ITS IMPACT ON NUCLEAR POWER PLANTS. I. Application of the FWPCA and Related Legislation to Individual Dischargers Through Permit Programs. Davis, J. P. Nucl. Safety; 15: No. 3, 262-275(1974).

The new Federal Water Pollution Control Act (enacted in October 1972) and its impact on the regulation of nuclear power facilities are discussed. The permit program for the National Pollution Discharge Elimination System, which replaces the Refuse Act Permit Program and requires a permit for the discharge of any substance to the waterways of the United States is described. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 8348, 8355, 8561, 8565, 8707, 8714, 8733, 8734, and 8868.

6595 (AD-734062) DESIGN OF ELECTRONIC CIRCUITRY FOR SOLAR WIND AND RELATED EXPERIMENTS. Final Report, 25 October 1965 - 30 June 1969. Rizzo, A. G.; Tauro, E. (Spacetac, Inc., Bedford, Mass. (USA)). Jul 1969. Contract AF19(628)5727. 42p. (SPACETAC-106045; AFCRL-71-393). NTIS $3.00.

The material presented in this document represents the final technical report for the design of electronic circuitry for the magnetic storm and related experiments to be carried aboard the Magnetic Storm Satellite. The circuitry represented herein are those required for the conduct of experiments aboard satellite payloads which travel into deep space to study phenomenon related to the interaction of the solar plasma with the earth's magnetic field. These phenomena generally take place at distances more than 50,000 miles from earth thus dictating severe size and power strictures on the circuitry and payloads to allow for maximum booster capability. (auth)

6596 (BNWL-tr-111) DETECTION OF ALPHA PARTICLES BY SEMICONDUCTORS. Application to the Control of Plutonium Extraction. Tanguy, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 20 Mar 1974. Translation of CEA-R-3442. 168p. Dep. NTIS $11.50.

The design and operation of a surface barrier semiconductor detector system for continuously measuring the activity of alpha emitters in solution in a plutonium extraction plant is described. After a review of the properties of the semiconductor detectors and a description of the electronics for alpha detection, a theoretical study of the alpha spectra from a thick source is given. The operation and performance of the device for measuring alpha emitter concentrations in solutions is described. The effect of beta-gamma flux on alpha detection is studied to determine the limitations introduced by this secondary flux. The response rate of the detector is studied by calculating the charge collection time, and the adaptation of a rapid amplification chain to the detector for alpha/beta gamma discrimination and pulse pileup reduction is examined. With the system developed, it is possible to determine plutonium in solutions containing other alpha emitters (americium and uranium) and very active fission products. (WHK)

6597 (CONF-740612-1) LOW-POWER HYBRID IC ELECTROMETER AMPLIFIERS. De Lorenzo, J. T.; Kennedy, E. J.; Tucker, C. H. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 8p. Dep. NTIS $4.00.

From government microcircuit applications conference; Boulder, Colorado, USA (25 Jun 1974).

A hybrid IC electrometer amplifier that dissipates <4 mW was designed for portable radiological survey meters. An alternative design with greater open-loop gain was developed for application in line-powered instruments. Preliminary measurements indicate better than a factor of 10 improvement in input leakage over a discrete design. Several amplifiers of each type were fabricated, and the results of long-term stability approach that of all-monolithic types. The all-ceramic package and a carefully guarded structure has also resulted in excellent performance in a high humidity environment. (auth)

6598 (INIS-mf-887-1, pp 163-174) COMPARISON OF RADIOMETRIC GAGES FOR MONITORING ARTIFICIAL RADIOACTIVE AEROSOL CONCENTRATIONS. Dvorak, V. (Tesla, Premysleni, Czech). [nd]. (In Czech).

A general classification is presented of gages for monitoring artificial radioactive aerosols. Detectors are classified according to design and function. Methods are briefly described used to compensate the effect of natural radioactive aerosols. (INIS)

6599 (INIS-mf-1260) POWER SUPPLIES FOR PORTABLE GAMMA RATEMETERS. Miniature Gamma Ratemeter. de Menezes, F. S. (Instituto de Pesquisas Radioactivas, Belo Horizonte (Brazil)). 1973. 12p. (In Portuguese). INIS.

The design of two stabilized power supplies, one for high voltage and the other for both low and high voltages, is presented. These supplies are designed for portable gamma ratemeters, using Geiger-Mueller counters. The design of a miniature gamma ratemeter is also discussed, together with a review of the basic blocking oscillator theory. A comparison is drawn between power supplies using blocking oscillators and sinusoidal oscillators. (INIS)

6600 (JEN-262) ELECTRONIC DETECTION OF NUCLEAR RADIATIONS. Campos, J. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 31p. (In Spanish). INIS.

Electronic detection of nuclear radiations is studied as well as different types of detectors and the transmission of output impulse from these detectors. Matching signal preamplifiers and amplifiers for the impulses provided by the detectors have been specially studied. Finally the problems raised by a high rate of impulse arrival and by noise are considered. (auth)

6601 (JUL-1021-FF) BEHAVIOR OF SEMICONDUCTOR DEVICES AT LOW TEMPERATURES. Lengeler, B.; Matula, S.; Spormann, J.; Durcansky, G. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Nov 1973. 106p. (In German). Dep. NTIS (US Sales Only) $8.50.

The temperature behavior of the most important semiconductor properties was investigated and literature data compiled. The properties studied are band gap, ionization energy of impurity atoms, density of free charge carriers, mobility, electric and thermal conductivity, impact ionization, life-time of charge carriers, and noise. The following components were studied: diodes, varactor diodes, Zener diodes, tunnel diodes, Si and Ge semiconductor detectors, bipolar transistors and FET's. The measured results are compared with those of other authors and discussed. A hf oscillator is described for the measurement of magnetic fields by means of NMR. (79 references) (GE)

6602 (LBL-1(Vol.4)(Add.1)) INSTRUMENTATION FOR ENVIRONMENTAL MONITORING: BIOMEDICAL. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. 59p.

A comprehensive survey of instrumentation for environmental monitoring is being carried out by the Lawrence Berkeley Laboratory under a grant from the National Science Foundation. Instruments being investigated are those useful for measurements of Air Quality, Water Quality, Radiation, and Biomedical Parameters related to environmental research and monitoring. Consideration is given to instruments and techniques presently in use and to those developed for other purposes but having possible applications to this work. The results of the survey are given as (a) descriptions of the physical and operating characteristics of available instruments, (b) critical comparisons among instrumentation methods, and (c) recommendations of promising methodology and development of new instrumentation. The survey material is compiled in loose-leaf volumes which are periodically updated. Presented is an update for Vol. 4 on Biomedical Parameters. The section on biomedical radiation measurements for environmental protection is included. An overview of the main considerations for making measurements of radionuclide body burdens in the human body is given. (WHK)

6603 (ORNL-TM-4574) ANALYSIS OF GAS BREAKDOWN INTEGRATING IONIZATION CHAMBERS. Rochelle, J. M. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 198p. Dep. NTIS $13.00.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

A theoretical analysis to describe the operation of a gas discharge ionization chamber circuit in terms of fundamental discharge gap parameters is given. Voltage breakdown of the gap is a statistical phenomena which contributes a statistical component to the total dose pulse. An analysis of this statistical component is given. The average gap current which develops just prior to breakdown can cause serious measurement errors with small chambers. An analysis of this effect is given. The criteria for obtaining a self-sustained Townsend current in the gap are delineated, and a qualitative analysis of the effects of pressure and geometry is also included. Where possible the result of each theoretical analysis is checked with experiments using commercially available neon glow discharge devices (test gaps). Important parameters for these test gaps are given. (WHK)

6604 (SGAE-2151) EVALUATION OF SIMULTANEOUSLY MEASURED β-EMITTING RADIONUCLIDES. Krejsa, P.; Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Jul 1973. 8p. (STS-15-73). INIS.

For the simultaneous determination of β-emitters in multi-labelled samples by liquid scintillation counters, an evaluation method based on counting probabilities of each decay was de-

veloped. After measurement of the sample at different channel settings, the activity of each present radionuclide can be computed. (auth)

6605 (UCRL-75207) DELAY LINE READOUTS FOR HIGH PURITY GERMANIUM MEDICAL IMAGING CAMERAS. Kaufmann, L.; Camp, D. C.; McQuaid, J. H.; Armantrout, G. A.; Swierkowski, S. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Nov 1973. 8p. (CONF-731112-34). Dep. NTIS $4.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

High-purity germanium offers excellent potential for use in nuclear medical imaging cameras. A position and energy readout technique using two inexpensive delay lines has been developed for these cameras. Results obtained with a 1-cm^2, 4 mm deep, 5 × 5 strip high purity germanium detector are 2.1 mm full width spatial resolution, a measured single strip resolution of 0.65 mm full width half maximum (FWHM), a 25 element uncollimated energy resolution of 2.95 keV FWHM, and 2.65 keV FWHM for a single central element at 140 keV. (auth)

6606 SENSITIVE DETECTOR SYSTEM FOR THE CONTINUOUS MONITORING OF TRITIUM IN THE AIR. Singh, A. N.; Kadwani, M. G. (Bhabha Atomic Research Centre, Bombay). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 188-193(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power symposium; San Francisco, CA (14 Nov 1973).

A new design of a flow cell type of scintillation detector system suitable for continuous monitoring of tritium in the ambient air has been developed. The detector records 2500 counts per second with a single photomultiplier tube type EMI 9514S for 1 MPC level of tritium activity release at 50 counts per second background and 2.5% counting efficiency. Possibility of designing detectors with an efficiency, comparable to that of liquid scintillators, has been discussed. The cell, filled with plastic scintillator powder, does not show any background build up over long periods of operation and has a low gamma response. The performance of the detector has been studied in detail and a complete tritium monitoring set up is described. (auth)

6607 HIGH PRESSURE XENON PROPORTIONAL CHAMBER FOR X-RAY LAMINOGRAPHIC RECONSTRUCTION USING FAN BEAM GEOMETRY. Boyd, D. (Stanford Univ., CA); Coonrod, J.; Dehnert, J.; Chu, D.; Lim, C.; Macdonald, B.; Perez-Mendez, V. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 184-187(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A novel 50 cm long position sensing proportional chamber has been constructed for use in transverse section reconstruction measurements. Characteristics of this detector are: position resolution 1 mm, energy resolution 20%, efficiency at 60 keV 31%, and deadtime 2 μsec. Fan beam x-ray transmission measurements at many angles are stored in a PDP 11/45 minicomputer which performs and displays the density reconstruction in a 64 × 64 array encompassing the cross sectional contour of the scanned object. (auth)

6608 MULTIWIRE PROPORTIONAL CHAMBER FOR IMAGING THERMAL, EPICADMIUM, AND FAST NEUTRONS. Valentine, K. (Univ. of California, Berkeley); Kaplan, S.; Perez-Mendez, V.; Kaufman, L. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 178-183(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The 25 cm × 25 cm chamber described images thermal and epicadmium neutron beams using two boron-coated conversion screens, and fast neutrons using a single polyethylene converter. Sample images and quantitative attenuation and resolution data are presented. Measurements of neutron attenuation in lucite patterns give good agreement with expected values for thermal, epicadmium, and fast (Pu–Be) beams. The measured mean free paths were 0.30, 0.81, and 5.8 cm, respectively. Thermal neutron resolution (0.2 cm) depends upon α-particle range, but resolution for fast neutrons (0.4 cm) appears to be limited by chamber thickness (to approximately one-half of the chamber thickness). Measurements involving digital image storage and manipulation are also described and illustrated. (auth)

6609 PHOTON COUNTING WITH FIBER-OPTIC COUPLED SCINTILLATORS. Swinth, K. L. (Battelle Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1830. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 119-124(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

By coupling a scintillation crystal to a photomultiplier with fiber optics, one can place the detector in areas not normally accessible to a crystal-photomultiplier combination. Although fiber optics provide a flexible optical coupling, serious light losses cause about a factor of 10 reduction in the light intensity reaching the photomultiplier. Most of the light loss is due to the small acceptance angle of the fiber optics with transmission losses and crystal aperture losses playing secondary roles. Attention to the design and to the selection of the crystals and fiber optics help to optimize the light collection efficiency. The light losses lower the scintillation intensity from low-energy (10 to 40 keV) radiation into the region where photomultiplier noise becomes important (3.5 to 18 photoelectron equivalents). This noise consists of Cherenkov events, faceplate scintillations, electroluminescence, afterpulses and thermionic emissions. For effective low background counting this noise must be reduced. A combination of pulse-shape discrimination, magnetically limiting the photocathode area and shielding were effective in reducing the background rate from 513 ± 3 counts/minute to 10.0 ± 0.5 counts/minute in the energy range from 6.5 to 40 keV. By coincidence counting, in the same energy region, a background rate of 1.60 ± 0.28 counts/minute was obtained. (auth)

6610 NEW NEAR-INFRARED AND ULTRAVIOLET GAS-PROPORTIONAL SCINTILLATION COUNTERS. Thiess, P. E.; Miley, G. H. (Univ. of Illinois, Urbana). Contract AT(11-1)-2007. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 125-145(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power symposium; San Francisco, CA (14 Nov 1973).

New studies of gas-proportional scintillation counters have been performed using a large alpha source, reasonable spectral resolution (<25-Å), and including the strong near-infrared transitions in noble gases excluded in all previous studies. The results indicate that several new gas mixtures show promise for detectors to measure the neutron fluxes in a reactor over a wide range of values and in many nuclear physics applications where fast response and good energy resolution are desired. When used with an isotopic source the device can be used as a portable, variable-intensity light source or to detect trace amounts of atmospheric contaminants such as CO, NO, and Hg. The work also has provided useful data for laser systems pumped by ionizing radiation as well as for the operation of plasma display panels. (94 references) (auth)

6611 PHOTOMULTIPLIER SELECTION CRITERIA FOR SATELLITE EXPERIMENTS. Andresen, R. D.; Leimann, E. A. (European Space Research and Tech. Centre, Noordwijk, Netherlands). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 106-118(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Forty-six RCA C 7151 Q photomultiplier tubes and thirty-five EMI 9711 NB photomultiplier tubes have been tested for use in the telescope of the COS-B gamma-ray experiment. The tubes were selected taking into account gain, linearity, fatigue behavior and temperature characteristics. Besides identifying the most suitable tubes for this application, the experimentally determined values make it possible to derive "typical" behavior parameters which can be used to pre-select tubes at the ordering stage. The results obtained with the EMI tubes clearly demonstrate a striking difference between "typical" catalogue values and "typical" measured values for the batch tested. (auth)

6612 RECENT DEVELOPMENTS IN DELAY LINE READOUT OF MULTIWIRE PROPORTIONAL CHAMBERS. Perez-Mendez, V. (Univ. of California, Berkeley); Parker, S. I. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 45-50(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The application of electromagnetic delay line readout methods for determining the track positions of ionizing particles in multiwire proportional chambers is described. Construction techniques for large area chambers, which allow the use of all three planes for track position measurements are given. The construction and characteristics of electromagnetic delay lines optimized for wire chamber readout are discussed. (auth)

6613 SIGNAL, NOISE, AND RESOLUTION IN POSITION-SENSITIVE DETECTORS. Radeka, V. (Brookhaven National Lab., Upton, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 51-64(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

An analysis is presented of signal, noise and position resolu-

tion relations for some of the most interesting position-sensing methods. "Electronic cooling" of delay line terminations is introduced in order to reduce noise in the position-sensing with delay lines. A new method for terminating transmission lines and for "noiseless" damping which employs a capacitance in feedback is presented. It is shown that the position resolution for the charge division method with resistive electrodes is determined only by the electrode capacitance and not by the electrode resistance, if optimum filtering is used. (auth)

6614 RESPONSE OF MULTIWIRE PROPORTIONAL CHAMBERS TO RELATIVISTIC HEAVY NUCLEI. Pollvogt, U.; Kurz, R. J. (TRW Systems Group, Redondo Beach, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 70-74 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Measurements have been carried out at the Lawrence Berkeley Laboratory Bevatron to investigate the response of multiwire proportional chambers to 2.1 GeV/nucleon ^{12}C and ^{16}O nuclei. The relative gas gain as a function of high voltage was measured for three different gases: 80% Ar/20% CO_2, 75% Ar/25% C_4H_{10}, and 81% Ar/14% Xe/5% CO_2. The gas gain obtained with 5.9 keV x-rays from ^{55}Fe sources was also measured for comparison. Saturation characteristics of the chambers are analyzed and the implications of the results on the use of multiwire proportional chambers as spatial detectors in cosmic ray experiments are discussed. A summary of the results of delta ray calculations and their effect on spatial resolution is also presented. (auth)

6615 LOW TEMPERATURE CHARACTERISTICS OF ION IMPLANTED SILICON POSITION SENSITIVE DETECTORS. Elad, E.; Sareen, R. (ORTEC, Inc., Oak Ridge, TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 75-84(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov. 1973).

The operation of ion implanted silicon position sensitive detectors at low temperatures is described. The improved noise performance of the detector at these temperatures in both the energy and position modes is analyzed and its implications on low energy applications is discussed. A large part of the investigation is devoted to the study of boron implanted resistors and their noise properties both at room temperature and cryogenic temperatures. (auth)

6616 CHARACTERISTICS OF MULTIWIRE PROPORTIONAL CHAMBERS FOR POSITRON IMAGING. Lim, C. B.; Chu, D.; Kaufman, L.; Perez-Mendez, V.; Sperinde, J. (Univ. of California, San Francisco). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 85-88(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Multiwire proportional chambers (MWPC) designed for use in a positron camera for Nuclear Medicine applications are described. The coordinates of the two annihilation gamma rays are detected in the chamber by their interaction with thin lead converters placed on both faces of each chamber. In order to obtain reasonable efficiencies (10%) the lead converters have been made in a square honeycomb-like structure, which increases the effective surface area and also permits the application of a drift field to extract the electrons into the active area of the MWPC. (auth)

6617 NEEDLE CHAMBER: A NEW TYPE OF X-Y DETECTOR USING THE PROPERTIES OF GASEOUS MULTIPLICATION. Grunberg, C.; Le Devehat, J. (CEN de Saclay, Gif-sur-Yvette, France). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 89-92(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A new type of detector, based on gaseous multiplication is presented. It is made of needle arrays, each needle behaving as an independent proportional counter. Thus, it has advantages of multiwire-proportional chambers and many others, mainly high-counting rate per surface unit, high mechanical reliability. All these features make this counter of large interest in a number of fields. (auth)

6618 HIGH-ACCURACY POSITION MEASUREMENTS WITH DRIFT CHAMBERS AND PROPORTIONAL CHAMBERS. Charpak, G. (CERN, Geneva). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 38-44(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

By constructing multiwire drift chambers with a uniform electric field saturating the drift velocity, a perfectly linear response is obtained over all the chamber. The accuracy is close to $\sigma =$ 100 μm. A similar accuracy is obtained for inclined tracks and in magnetic fields of the order of 1 tesla. By measuring the center of gravity of avalanches a very high accuracy is obtained in the measurement of the two coordinates of avalanches in a single gap of a proportional chamber. The applications of the method to the mapping of spatial distributions of soft X-rays are discussed. (auth)

6619 COMPUTER ALGORITHMS AND DETECTOR ELECTRONICS FOR THE TRANSMISSION X-RAY TOMOGRAPHY. Cho, Z. H.; Ahn, I. S.; Tsai, C. M. (Univ. of California, Los Angeles). Contract AT(04-1)Gen-12. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 218-227(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The problem associated with transmission tomography and its implications in solving large numbers of simultaneous equations and associated parameters, such as multimillion weighting factors, is studied. Mathematical approaches to this problem in several directions are briefly reviewed and a technique (linear superposition technique with compensation) developed for this purpose, along with results obtained with this method is presented. Another important aspect of the multiple scanning tomography is counting statistics which requires the count rate be in the order of 5 MHz or more for the pulse counting to have statistical accuracy of 0.5% or better. Several alternative detectors besides conventional Sodium Iodine (NaI(Tl)) detector, namely, plastic scintillator (with enhanced photoelectric absorption by, for instance, tin loading) and various semiconductor detectors, such as CdTe and possible HgI_2 are under investigation. (WHK)

6620 DUAL ENERGY ANALYSIS USING PHOSWICH SCINTILLATION DETECTORS FOR LOW-LEVEL IN-VIVO COUNTING. Shapiro, E. G.; Anderson, A. L. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 201-209(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Electronics developed for a whole body counting system analyze the pulse heights of signals from both the sodium iodide (NaI(Tl)) and cesium iodide (CsI(Na)) crystals of a phoswich scintillation detector. Pulse shape discrimination is used to determine the origin of the scintillation, NaI or CsI, while rejecting coincident Compton-scattered events and photomultiplier tube noise. Both energy spectra are accumulated simultaneously in separate memory quadrants of a multichannel analyzer. The system allows for low-energy (5 keV to 125 keV) x-ray analysis from the NaI(Tl) crystal and high-energy (100 keV to 2.5 MeV) x-ray or γ-ray analysis from the CsI(Na) crystal. The discrimination system is better than 95% efficient over both energy ranges, with a low-energy (12 to 24 keV) shielded background count of less than 2 cpm for a single 5-in.-diam phoswich detector. This system thus extends the detector's normal energy range by more than an order of magnitude. (auth)

6621 CALCULATION OF THE SELF-ABSORPTION IN SPHERICAL RADIOACTIVE SOURCES. Francois, J. P. (Ghent Univ.). Nucl. Instrum. Methods; 117: No. 1, 153-156(1974).

In the literature, a closed formula has been derived for computing the self-absorption of gamma-rays emitted isotropically from a spherical source. Two other proofs for this relation are given. (auth)

6622 FURTHER STUDY OF TIMING PROPERTIES OF SCINTILLATION COUNTERS. Bialkowski, J.; Moroz, Z.; Moszynski, M. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Instrum. Methods; 117: No. 1, 221-226(1974).

The study of time resolution as a function of the triggering fraction C/R for the scintillation counter consisting of an XP1021 photomultiplier and a 1.25 cm × 0.2 cm NE111 scintillator was performed. The scintillator was irradiated by β-rays of ^{60}Co. The C/R curves measured for some selected energy windows between 25 keV and 200 keV were normalized and compared with the calculated curve according to Hyman theory. The good fit of the theoretical curve to the experimental one shows that Hyman theory describes well the timing properties of the plastic scintillation counters. (auth)

6623 EFFECT OF A FINITE TIME-RESOLUTION ON THE TIME-DIFFERENTIAL DIRECTIONAL CORRELATION. Morinobu, S. (Tokyo Inst. of Tech.); Ikegami, H. Nucl. Instrum. Methods; 117: No. 1, 249-252(1974).

The effect of a finite time resolution on the differential measurement of the perturbed directional correlation is discussed. The effect is shown to cause amplitude attenuations and time-scale shifts in the correlation function. Numerical results are given for three typical shapes of the prompt timing curve. (auth)

6624 LIFETIME SYSTEM WITH STABILIZED TIMING DISCRIMINATORS. Hall, T. M. (Brookhaven National Lab., Upton, NY). Nucl. Instrum. Methods; 117: No. 1, 253-259(1974).

A lifetime system capable of making highly reliable measurements of the very short decay components (≲100 ps) characteristic of positron annihilation in metals containing vacancies is described. This system has several features which serve to reduce, by an order of magnitude, some of the systematic timing errors usually found in lifetime systems. Under normal operating conditions the time shift with pulse height, the time shift with changes in ambient temperature, and the time shift with counting rate are all less than or equal to 5 ps. (auth)

6625 SECOND VERSION OF A CONSTANT-FRACTION TRIGGER REDESIGNED WITH NEW INTEGRATED CIRCUITS AND RESULTS WITH SEMICONDUCTOR DETECTORS. Maier, M. R.; Landis, D. A. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 117: No. 1, 245-247(1974).

A design of the constant-fraction trigger with recently introduced integrated circuits is given. Results are quoted for the time resolution with germanium detectors. These were obtained with a circuit modification to suppress tails in the time spectra associated with slow rising pulses. (auth)

6626 DEPENDENCE OF Ge(Li) TIMING INFORMATION ON GAMMA-RAY INTENSITY DISTRIBUTIONS. Coulter, P. G.; Evans, H. C.; Robertson, B. C. (Queen's Univ., Kingston, Ont.). Nucl. Instrum. Methods; 117: No. 1, 239-243(1974).

The dependence of timing information on γ-ray intensity distribution obtained from a true coaxial Ge(Li) detector and a constant-fraction trigger is calculated. A simple model is used for both the Ge(Li) detector and constant-fraction trigger. Mean trigger-time shifts as large as several ps are obtained for large γ-ray anisotropies. The effect of using other types of timing discriminators is discussed. The relation between γ-ray interaction position and timing signal is also calculated and compared with experimental measurements; good agreement is obtained over the normal working range of the constant-fraction trigger. (auth)

6627 ENERGY-TRANSFER AND LIGHT-COLLECTION CHARACTERISTICS FOR DIFFERENT TYPES OF PLASTIC SCINTILLATORS. Bengtson, B.; Moszynski, M. (Univ. of Aarhus, Denmark). Nucl. Instrum. Methods; 117: No. 1, 227-232(1974).

The growth of the light pulse from the binary plastic NE 111 and the ternary plastics Naton 136 and NE 102A was studied with respect to the radiation impinging time. The scintillators were irradiated with ^{60}Co gamma rays, and Cherenkov light generated inside the photomultiplier front glass was used as a "built-in" zero-time reference in a time-distribution measurement. Well-resolved prompt time distributions were obtained for an average of 20 photoelectrons. The probability density function related to energy-transfer time was found to be of Gaussian shape, in agreement with a previous suggestion. For NE 111, the standard deviation σ'_{ET} of the energy-transfer time is 0.2 ns. For Naton 136, the σ'_{ET} is 0.5 ns, in excellent agreement with a previously extracted value. A study of the light-collection process leads to the conclusion that a scintillating plastic cannot be considered as a simple light guide to its own light. The transport velocity of light falling directly on a photocathode is found to be about 50% slower than estimated from the refractive index of the base plastic. The standard deviation σ'_t of the single-photon transit-time distribution for a 2.5 × 2.5 cm cylindrical scintillator is 0.4 ns, in good agreement with a previous estimate. The disagreement reported previously with the value of σ'_t which was theoretically estimated by Cocchi and Rota is removed when the measured average transit velocity of photons is used in their calculation. (auth)

6628 METHOD FOR DETERMINATION OF SHORT HALF-LIVES IN A STREAMING SYSTEM. Baechmann, K.; Klonk, H. (Technische Hochschule, Darmstadt, Ger.). Nucl. Instrum. Methods; 117: No. 1, 261-265(1974). (In German).

In a streaming system the half-lives of short-lived nuclides (even with low activities) can be determined by repeating decay or build-up measurements in a cyclic mode. The mathematic principles for the calculation of the half-lives are given and the possible errors are discussed. (auth)

6629 RESOLUTION IN EXPERIMENTS OF ANGULAR CORRELATION OF ANNIHILATION PHOTONS. Stewart, A. T. (Queen's Univ., Kingston, Ont.). Nucl. Instrum. Methods; 117: No. 1, 309(1974).

An error in the paper of Poletti and Rossitto (Nucl. Instr. and Meth. 109(1973)557) concerning the resolution of the apparatus for angular correlation of positron annihilation photons is pointed out. (auth)

6630 TIME-DEPENDENT POLARIZATION OF CdTe γ-RAY DETECTORS. Bell, R. O.; Entine, G.; Serreze, H. B. (Tyco Labs., Inc., Waltham, MA). Nucl. Instrum. Methods; 117: No. 1, 267-271(1974).

A decrease in the counting rate and charge collection efficiency of p-type CdTe gamma-ray detectors, starting from the time of first application of the electric field, has been observed. Momentary removal of the bias returns the detector to its initial state. The behavior can be understood in terms of deep acceptors which detrap holes and decrease the thickness of the space charge region. Non-polarizing detectors can be made by using either high work function contacts with appropriate surface preparation or by periodic removal of the bias. (auth)

6631 GENERALIZED FIGURE OF MERIT FOR GAMMA-RAY POLARIMETERS. Logan, B. A. (Univ. of Ottawa); Jones, R. T.; Ljubicic, A. Nucl. Instrum. Methods; 117: No. 1, 273-275(1974).

A figure of merit, which can be applied in general situations, is proposed for gamma-ray polarimeters. An increase in the figure merit for a polarimeter gives a proportional decrease in the time necessary to achieve a given statistical accuracy. Various existing gamma-ray polarimeters are considered using the figure of merit as a basis for comparison. (auth)

6632 DIAMOND NUCLEAR RADIATION DETECTORS. Kozlov, S. F.; Belcarz, E.; Hage-Ali, M.; Stuck, R.; Siffert, P. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods; 117: No. 1, 277-283(1974).

It is shown that natural diamond can be used as a homogeneous conduction counter with near complete charge collection, even over a long period of time. Indeed, polarization effects have been suppressed by making the back contact of the detector injecting under the influence of the applied field in order to compensate for trapped charge carriers. The electric and detection characteristics of these counters have been investigated. Possible application fields are briefly discussed. (auth)

6633 GAMMA-RAY POSITION-SENSITIVE COAXIAL Ge(Li) DETECTOR. Sherman, I. S.; Strauss, M. G. (Argonne National Lab., IL). Nucl. Instrum. Methods; 117: No. 1, 285-294(1974).

The position of a γ-ray interaction in a true coaxial Ge(Li) detector is given in polar coordinates. Slots cut through the peripheral n-layer contact parallel to the detector axis divide the detector into effectively independent wedge-shaped sectors. The angular position of interaction is obtained by noting the sector in which a γ-ray is detected. The radial distance is determined from the difference between the rise and fall times of the recovered current pulse obtained from the p-core. Radial fwhm resolution of 1 mm was obtained with a 122 keV γ-ray beam in a 50 mm diameter detector. Non-linearity is less than 0.5 mm. The radial response is independent of angle. The position-sensing characteristics of the detector and the operation of the radius-determining pulse-shape analyzer are discussed. (auth)

6634 INTRINSIC SCINTILLATION EFFICIENCY OF PLASTIC SCINTILLATORS FOR ^{60}Co GAMMA EXCITATION. Clark, D. (Univ. of California, Livermore). Nucl. Instrum. Methods; 117: No. 1, 295-303(1974).

Various scintillators were exposed to the gamma rays from a ^{60}Co source, and the energy released per second by these scintillators as scintillation photons was determined by using a photodiode calibrated to a known electron/photon efficiency for a given scintillator. The number of scintillation photons at any given energy and the efficiency of the photodiode were determined. To ensure gamma-ray and electron equilibrium in the scintillator and to minimize light-trapping effects, the scintillators were spheres surrounded by a spherical shell of nonactivated scintillator base material (polystyrene). The gamma-ray energy absorbed per second by the scintillators was determined by measuring the gamma-ray flux with an "air-equivalent"-cavity ion chamber. The intrinsic efficiency (energy released per energy absorbed) was determined to an accuracy of ≈8% for Pilot-B, NE-102, and MEL-150C–i.e., (3.1 ± 0.3)%, (2.9 ± 0.2)%, and (2.5 ± 0.2)% respectively. In addition, the efficiency of stilbene was determined by this technique to be 5.1%; but, because of stilbene's anisotropic emission, the error in the measurement is uncertain. (auth)

6635 PRECAUTIONS IN THE MEASUREMENT OF TRITIUM CONCENTRATIONS IN AIR WHEN USING FLOW-THROUGH ION CHAMBERS. Waters, J. R. (Johnston Labs., Inc., Cockeysville, MD). Nucl. Instrum. Methods; 117: No. 1, 39-43(1974).

Instruments with flow-through ion chambers are frequently used to measure the concentration of tritium gas in air. However, these simple instruments can give erroneous results because of: cigarette smoke, aerosols, ions, ambient gamma-ray field changes,

moisture and condensation, absorption and memory effects, clogged filters, fission product gases, radon, and incorrect instrument calibration. The causes of these errors are explained and chart recordings are presented showing some of them in action. Most problems can be avoided using the proper instrument design and safeguards described and by adequate calibration techniques. A tritium monitor should be checked and calibrated with tritium gas, not gamma-rays or ions. The most accurate calibration is obtained when the instrument operates in a closed loop so that the tritium concentration is constant, a steady meter reading being obtained independent of air flow rate and instrumental time constants. (auth)

6636 SHAPED SCINTILLATION DETECTOR SYSTEMS FOR MEASUREMENTS OF GAMMA-RAY FLUX ANISOTROPY. Trombka, J. I.; Vette, J. I.; Stecker, F. W.; Eller, E. L.; Wildes, W. T. (Goddard Space Flight Center, Greenbelt, MD). Nucl. Instrum. Methods; 117: No. 1, 99-107(1974).

The detection efficiencies of cylindrical detectors for various gamma-ray photon angular distributions have been studied in the energy range from 0.10 MeV to 15 MeV. These studies indicate that simple detector systems on small satellites can be used to measure flux anisotropy of cosmic γ-rays and the angular distribution of albedo gamma rays produced in planetary atmospheres. The results indicate that flat cylindrical detectors are most suitable for measuring flux anisotropy because of their angular response function. A general method for calculating detection efficiencies for such detectors is presented. (auth)

6637 IN-DEPTH LOCALIZATION OF BETA-EMITTING ISOTOPES. Dependence of the Range of Applicability upon Maximum Energy and Complexity of the Spectrum. van de Geijn, S. C. (EURATOM-ITAL, Wageningen, Netherlands). Nucl. Instrum. Methods; 117: No. 1, 109-113(1974).

The method for the in-depth localization of β-emitting isotopes described before for ^{45}Ca is investigated for isotopes which are of importance in biology, emitting β-particles with a higher (^{32}P; 1710 keV) or lower (^{14}C; 154 keV) maximum energy or having accompanying β- or γ-radiation (^{89}Sr + ^{90}Sr and ^{22}Na). An analytical method for the background determination and subtraction is presented in the case of ^{22}Na. No disturbing influence of the preferential attenuation of lower-energy electrons has been found. The maximum localization distance is strongly dependent upon the maximum energy of the isotope, as expected. It varies from about 200 μm for ^{14}C to more than 3500 μm for ^{32}P (density 1 g/cm^3). (auth)

6638 SKYLAB X-RAY SPECTROHELIOGRAPH. Conroy, J.; Ballas, J.; Wester, E.; Boczenowski, J.; Holloway, J. (American Science and Engineering, Cambridge, MA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 237-246(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

On May 14, 1973, Skylab was placed in earth orbit by the National Aeronautics and Space Administration. The major scientific payload of this experimental space station is the Apollo Telescope Mount (ATM) which houses six major telescope instruments. As a group, these instruments are capable of observing the sun's radiation from x-rays to visible light. A brief description of the hardware and performance of one of these instruments, the x-ray spectroheliograph, is given. (WHK)

6639 NEGATIVE AFFINITY X-RAY PHOTOCATHODES. VanSpeybroeck, L. (Harvard Coll. Observatory, Cambridge, MA); Kellogg, E.; Murray, S.; Duckett, S. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 408-415(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

True image-forming telescopes for use in x-ray astronomy are available now with arc-second resolution for $\lambda \geq 3$A. Such telescopes have been very successfully applied on rockets and on the recent Syklab mission for solar observations. However, their application to observations of extra-solar x-ray sources has been severely limited due to a lack of sensitive x-ray imaging detectors. A new type of detector using a GaAs photocathode with quantum efficiency approaching 100% is described. This detector allows one to detect sources 10 to 20 times fainter than previously possible, while preserving spatial resolution on the several micron scale. Data on the x-ray photoelectron yield for GaAs (Cs-O_2) negative affinity cathodes both in reflection mode using a thick cathode and in the transmission mode using a 3.7 micron wafer are presented. A theoretical model is developed and compared with the data to determine the electron diffusion length, the front surface electron reflection coefficient and the back surface electron escape probability for the transmission cathode. There is good agreement between the crystal parameters obtained from x-ray data and from optical data. Application to x-ray telescope imaging in a practical device is discussed. (auth)

6640 COMPUTER-CONTROLLED SAMPLING SYSTEM FOR AIRBORNE RADIONUCLIDES. Koval, J. S.; Reichman, J. M.; Fry, C. O. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 465-469(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A computer-controlled air sampling system has been designed and is presently being constructed. The self-contained, mobile system will collect and record data from eight meteorological sensors. This information will be used in the study of resuspended airborne activity. Air sampler operation will be based on comparisons between the meteorological data and the sampling criteria selected by the operator at the beginning of the run. Correlations between meteorological parameters and resuspension will be used to develop a predictive model. A description of system hardware and discussion of the software concept are included. (auth)

6641 COMPUTER-COMPATIBLE FIELD MONITORING SYSTEM. Cassidy, M. E.; Watnick, S.; Negro, V. C.; Freeswick, D. C.; Graveson, R. T. (Atomic Energy Commission, New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 461-464(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The Field Monitoring System described is being used for long-term measurements of radiation dose rate in the vicinity of nuclear reactors. The output of a high pressure ionization chamber is converted to a binary number, which is written on a magnetic tape cassette every ten seconds. The digital recording permits direct entry of the data into a computer for analysis. The instrument is powered by a rechargeable plug-in battery pack. This permits complete flexibility in choice of monitoring sites. Through the extensive use of COSMOS integrated circuits, a modest sized battery pack yields 18 days operation. (auth)

6642 COMPUTERIZED SYSTEMS FOR ULTRALOW TEMPERATURE POLARIZED NUCLEI TIME REVERSAL AND PARITY EXPERIMENTS. Handy, L. E.; Steyert, W. A. (Los Alamos Scientific Lab., NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 857-861(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Experiments for studying nuclear polarization phenomena at ultralow temperatures require extreme precision in the collected data. The polarization of the applied field must be changed periodically and the data from gamma-ray spectra must be reduced as the experiment progresses. These experiments sometime run for days in order to obtain good statistical data and to reduce any errors induced by the system instrumentation. A computerized system used to automate the necessary control and data handling functions for this class of experiment is described. (auth)

6643 LOW NOISE JFET WITH INTEGRAL RESET DIODE. McKenzie, J. M.; Witt, L. J. (Sandia Labs, Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 794-797(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A low noise JFET has been built with a small diode diffused in the gate circuit for use as a charge sensitive preamplifier for a radiation detector. For these initial experiments the chips were bonded to an available 4-lead ceramic insulated header. Both dc and pulsed reset methods are possible. The present experiments with a dc reset method indicate that the device when optimized should give, at low count rates, similar resolution to opto-electronic feedback. An output count rate of 20,000 c/s at 6 keV adds 150 eV of noise. (auth)

6644 DIFFERENTIAL CURRENT PULSE PREAMPLIFIER FOR FISSION COUNTERS. De Lorenzo, J. T.; Clay, W. T.; Guerrant, G. C. (Oak Ridge National Lab., TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 757-762 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A current-pulse preamplifier with a differential input was developed for use with fission counters where there might be severe electrical interference. Tests with a vacuum tester coil show only a slight alteration of the normal noise background curve by the differential preamplifier but a great alteration by a single-ended preamplifier. Additionally, measurements show that if a differen-

tial current signal is obtained from the fission counter, the differential preamplifier can improve the signal-to-noise ratio (for electronic noise) nearly a factor of $\sqrt{2}$ over that of a single-ended unit. Tests of five prototypes built by a commercial manufacturer to RDT standards show good uniformity of performance, including gain stability, rise time, and linearity, well within the specified requirements. (auth)

6645 CAMAC APPLICATIONS IN NUCLEAR MEDICINE AT VANDERBILT: PRESENT STATUS AND FUTURE PLANS. Brill, A. B.; Parker, J. F.; Erickson, J. J.; Price, R. R.; Patton, J. A. (Vanderbilt Univ., Nashville). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 892-897(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

CAMAC has been used for data acquisition and control of nuclear measurement systems in the Vanderbilt University Nuclear Medicine Laboratory for approximately two years. The implementation of the CAMAC crate controller used with a PDP/9 computer is described. Data are acquired from three types of devices. These include a stationary multi-probe system, a computer driven scanner and a dual probe scanner not under computer control. Future extensions of the system are discussed, including the collection of data from higher data rate instruments (Anger-type scintillation camera) as well as computer networking. (auth)

6646 SCINTILLATION CAMERA. Blum, A. S. (Broward General Medical Center, Fort Lauderdale, FL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-21: No. 1, 695-696 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A stationary radionuclide imaging system employs a planar scintillation crystal viewed by multiple photodetectors. A new positioning technique allows use of signal information that must be discarded by conventional cameras. A calibrator generates photodetector signal patterns characteristic of known radiation source locations. Unknown sources are positioned by matching signal patterns of their radiations with the stored calibration signal patterns. The integral of individual location is displayed as a corrected image. (auth)

6647 DELAY LINE READOUTS FOR HIGH PURITY GERMANIUM MEDICAL IMAGING CAMERAS. Kaufman, L. (Univ. of California, San Francisco); Camp, D. C.; McQuaid, J. H.; Armantrout, G. A.; Swierkowski, S. P.; Lee, K. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 652-657(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

High purity germanium offers excellent potential for use in nuclear medical imaging cameras. A position and energy readout technique using two inexpensive delay lines has been developed for these cameras. Results obtained with a 1-cm^3, 4 mm deep, 5 × 5 strip high purity germanium detector are 2.1 mm full width spatial resolution, a measured single strip resolution of 0.65 mm full width half maximum (FWHM), a 25 element uncollimated energy resolution of 2.95 keV FWHM, and 2.65 keV FWHM for a single central element at 140 keV. (auth)

6648 PRACTICAL GAMMA-RAY CAMERA SYSTEM USING HIGH-PURITY GERMANIUM. Schlosser, P. A.; Miller, D. W.; Gerber, M. S.; Redmond, R. F.; Harpster, J. W.; Collis, W. J.; Hunter, W. W. Jr. (Ohio State Univ., Columbus). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 658-664 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A prototype gamma camera system has been constructed which is based on a high purity germanium detector fabricated with orthogonal strip electrodes. In this device, position sensitivity is obtained by connecting each contact strip on the detector to a charge-dividing resistor network. Excellent energy and spatial resolution have been achieved by cooling the resistor network to 77°K and by proper selection of noise filtering parameters in the pulse shaping amplifier circuitry. The significant advantage of employing this charge-splitting detector in a semiconductor gamma camera system is its electronic readout simplicity, requiring only three amplifier channels to measure the energy and two-dimensional location of gamma ray events. A discussion of the charge-splitting detector concept is presented with special reference to its potential use in the construction of a high resolution gamma imaging system having sufficient field of view and sensitivity for clinical utilization. (auth)

6649 LESION DETECTION CHARACTERISTICS OF A FOCUSING COLLIMATOR GAMMA CAMERA COINCIDENCE SYSTEM. Hart, H. E.; Rider, K.; Korenthal, J.; Spetsieris, P.; Bachman, A. (City Coll. of New York, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 665-677(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The radioisotope response characteristic of a proposed coincidence mode imaging system consisting of an appropriately designed focusing collimator with a gamma camera modified for second moment measurement is calculated for a range of design parameters. Analytic criteria for the detection of small filling defects imbedded in a radioactive medium are developed which directly relate to some of the practical complexities involved in lesion detection. The calculated performances indices of the system suggest that it may be possible to detect lesions significantly smaller than those currently observable. (auth)

6650 GAMMA-RAY IMAGING USING A FRESNEL ZONE PLATE APERTURE, MULTIWIRE PROPORTIONAL CHAMBER DETECTOR, AND COMPUTER RECONSTRUCTION. Macdonald, B.; Chang, L. T.; Perez-Mendez, V.; Shiraishi, L. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 678-684(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The use of the multiwire proportional chamber in a Fresnel zone plate coded aperture gamma-ray imaging system is described. Image reconstruction is by computer using the fast Fourier transform algorithm. Criteria for design parameters of the imaging system are established. A calculation of the signal/noise ratio of images reconstructed from computer-generated on-axis zone plate holograms gives values, for larger numbers of gamma-ray events, which are somewhat smaller than theoretical values based on a shot-noise formula. The use of a positive and a negative zone plate combination is shown to eliminate the large background usually associated with on-axis zone plate imaging. (auth)

6651 VIEW OF THE PRESENT STATUS AND FUTURE PROSPECTS OF HIGH PURITY GERMANIUM. Hansen, W. L.; Haller, E. E. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 251-259(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The present state of our knowledge of the properties of high purity germanium is reviewed. The role of excess vacancies, oxygen and high dislocation density in producing trapping in detectors is discussed. By the application of Fourier Transform Spectroscopy, the major impurities have been identified and aluminum has been found to be the dominant one in most crystals. Analysis has shown that the principal source of aluminum is the polycrystalline starting material. The material problems related to detector fabrication are surveyed and a spectrum taken with a 43 cm^3 coaxial detector is presented. It is concluded that the important problems of material development are well delineated but that their solutions will require intensified effort. (auth)

6652 CHEMICAL IMPURITIES AND LATTICE DEFECTS IN HIGH-PURITY GERMANIUM. Hall, R. N. (General Electric Co., Schenectady, NY). Contract AT(11-1)-3193. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 260-272(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The electrically active impurities remaining in high-purity germanium have been identified by means of far infrared photoconductivity measurements. The principal donor is phosphorus, often accompanied by lithium and another donor which is believed to be the LiO^+ complex. The acceptors present in undoped crystals are boron and aluminum. The tip ends of germanium crystals were examined by mass spectrograph, electron microprobe, and emission spectrograph analyses in a search for the possible presence of unsuspected impurities. The principal elements found were Ag in a first generation crystal and In when traces of this element had been intentionally added. Lattice defects have been studied by means of low temperature annealing and quenching experiments. Acceptor defects found in as-grown crystals can be eliminated by annealing. Two other defects which anneal in the 20–160°C range are found in quenched samples. (auth)

6653 HIGH PURITY GERMANIUM: LOW TEMPERATURE HALL ANALYSIS. Wichner, R.; Swierkowski, S. P.; Armantrout,

G. A. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 273-278(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A synopsis of results of low temperature (to ~7°K) Hall measurements on 58 samples of high purity germanium obtained from six laboratories in the U. S., Canada, and Europe is presented. The measurements show the presence of deep (Cu) and shallow level (Group III and V) chemical impurities as well as deep energy levels associated with complex vacancy and/or oxide defects. In general, it was found that high purity germanium tends to be rather well compensated, i.e., the individual acceptor or donor concentrations are typically 3 to 10 times that of the net carrier concentration at 77°K. The results show that as far as chemical impurities are concerned, Cu contamination is generally a problem at those laboratories using resistance-heated pullers. Shallow level impurity problems seem to be associated with Al most frequently, with some boron contamination observed. The presence of defect-related deep levels has also been observed. (auth)

6654 IMPURITIES IN HIGH-PURITY GERMANIUM AS DETERMINED BY FOURIER TRANSFORM SPECTROSCOPY. Haller, E. E.; Hansen, W. L. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 279-286 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Fourier Transform Spectroscopy in the wave number range between 0 and 125/cm^1 (0 to 15 MeV) was used to determine the impurities producing shallow energy levels in high-purity germanium. The sensitivity of the method is sufficient to detect impurities at a concentration of 10^9/cm^3 with excellent signal to noise ratio and the selectivity (energy resolution) allows a clean separation of all shallow levels. So far only net-concentrations can be observed so that it was necessary to measure n- and p-type material separately. The elements boron, gallium and indium appear to follow the expected segregation laws, while aluminum seems to be homogeneously distributed in the whole crystal. It has proven difficult to investigate n-type material due to the inability to produce low-noise electron-injecting contacts at the measuring temperatures (6 to 11°K). (auth)

6655 COAXIAL DETECTORS FROM HIGH PURITY GERMANIUM. Marler, J. M.; Hewka, P. V. (General Electric Co., Philadelphia). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 287-295(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The fabrication and performance of coaxial gamma radiation detectors from high purity germanium are discussed, and equations are presented which characterize a coaxial detector as a function of size, bias voltage, and impurity concentration. The coaxial detectors discussed have fully depleted volumes from 7 cm^3 to 76 cm^3. (auth)

6656 CORRELATION OF LOCAL TRAPPING WITH CRYSTAL DEFECTS BY DIRECT OBSERVATION OF ELECTRON LOSS IN A COAXIAL Ge(Li) DETECTOR. Strauss, M. G.; Sherman, I. S.; Bannon, R. W. (Argonne National Lab., IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 296-301 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A propeller-shaped region of reduced full-energy-peak efficiency was observed on the face of a true coaxial Ge(Li) detector. A similar pattern on the etch-pit photograph suggests that the propeller blades correspond to the 111 symmetry axes of the crystal. Spectra obtained when a 122 keV γ-ray beam was directed at this degraded region show a low energy tail which is not present when the beam is directed at normal regions. Current pulses corresponding to γ-rays that interact in the propeller region have shapes that show deficiencies in the electron component. Thus, degraded crystal regions that are revealed by etch-pit distributions can be correlated to local detector performance by direct observation of trapping rather than only by inference from the presence of tails in the energy spectra. (auth)

6657 RECENT ADVANCES WITH HgI_2 X-RAY DETECTORS. Swierkowski, S. P.; Armantrout, G. A.; Wichner, R. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 302-304(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

HgI_2 x-ray detectors up to 16 mm^2 have been made from single crystals grown from the vapor phase. Crystal growth, detector fabrication, and transport properties are described. Resolutions of 850 eV FWHM at 5.9 keV and 4.3 keV FWHM at 122 keV have been measured at 25°C in air. (auth)

6658 PRELIMINARY STUDIES OF CHARGE CARRIER TRANSPORT IN MERCURIC IODIDE RADIATION DETECTORS. Llacer, J. (Univ. of California, Los Angeles); Watt, M. M. K.; Schieber, M.; Carlston, R.; Schnepple, W. Contract AT(04-1) Gen-12. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 305-314(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Mercuric iodide single crystals have been grown by static and dynamic sublimation methods. Characteristics of contacts and detector capacitance have been studied by photon excitation methods. Gamma and x-ray spectrometry has been carried out with completed detectors showing resolutions comparable to the best results published to date. A measurement of hole trapping length has been made from the spectral shapes observed and has been found to be approximately 0.3 mm. Transient waveform analysis with alpha-particle excitation shows hole mobilities of approximately 3 cm^2/V-sec for a highly purified crystal and 0.05 for an expected less pure crystal. Electron mobilities of 120 cm^2/V-sec are observed. An attempt is made to explain the observed transient waveforms in terms of a single dominant trap model, with only partial success. Due to the strongly excitonic character of the material, it is proposed that the unfamiliar observations made regarding transport properties with the HgI_2 detectors studied may be due to exciton dissociation under high electric fields, to long exciton lifetimes and to interactions between excitons and trapping centers in the material. (auth)

6659 *CdTe* DETECTORS FROM INDIUM-DOPED TELLURIUM-RICH SOLUTIONS. Zanio, K.; Krajenbrink, F.; Montano, H. (Hughes Research Labs., Malibu, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 315-321(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Semi-insulating CdTe was grown from indium-doped tellurium-rich solutions. Ten $\frac{1}{2}$ cm^3 devices were fabricated with resolutions as low as 6% (FWHM) for ^{137}Cs. Polarization phenomena were not observed for tests performed from −36 to 65°C. Full energy peak counting efficiencies were less than theoretically predicted because of trapping. In addition, resolutions as low as 3 keV for ^{241}Am were obtained with smaller (≈15 mm^3) devices. (auth)

6660 POLARIZATION PHENOMENA IN CdTe NUCLEAR RADIATION DETECTORS. Malm, H. L.; Martini, M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 322-330(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Nuclear radiation detectors made from high resistivity chlorine doped cadmium telluride grown by the traveling heater method were evaluated. Short term performance for α, β, and γ radiations was good but the long term performance (>1 min) was degraded by a decrease in the full energy pulse height and γ-ray efficiency with time after the bias voltage was applied. A model which considers the effects of deep acceptors which slowly ionize (~10^3 s) to an equilibrium concentration ~5×10^{11}/cm^3 can explain the experimental findings on the changes of pulse shape, pulse amplitude, capacitance, energy resolution, and γ-ray efficiency with time. The operating conditions required for satisfactory stability in these detectors may be inconvenient to the user. (auth)

6661 CHARACTERIZATION OF THE TRANSPORT PROPERTIES OF HALOGEN-DOPED CdTe USED FOR GAMMA-RAY DETECTORS. Bell, R. O. (Tyco Labs., Inc., Waltham, MA); Wald, F. V.; Canali, C.; Nava, F.; Ottaviani, G. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 331-341(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The mobilities, trapping times, activation energies, and trap concentration have been measured for both holes and electrons in Br and Cl-doped CdTe using the time-of-flight technique. Two electron traps 25 and 50 MeV below the conduction band and two hole traps 140 and 350 MeV above the valence band have been found. The 10 times larger concentration of levels found in the Br-doped CdTe can be explained using a model that describes the association of cadmium vacancies and substitutional halogens. The physical interpretation of the $\mu\tau^+$ product when two levels are present is discussed for this case where the mobility is reduced and the lifetime is increased by trapping-detrapping phenomena.

The measurements demonstrate that the material has excellent potential for γ-ray detectors that do not polarize with the proper surface preparation and make good detectors (6 keV FWHM for 122 keV γ-ray). (auth)

6662 IMPROVED TECHNIQUE FOR THE GROWTH OF ULTRA-PURE GERMANIUM. Corley, R. A. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 342-343(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

It has been demonstrated that by utilizing a new method of multiple pulling, it is possible to consistently produce 3 inch diameter germanium crystals with net carrier concentrations in the low 10^{10}/cc range. This method involves two factors which are used to full advantage: (1) the germanium is purified as a result of the normal segregation of impurities, and (2) the usual handling and etching of furnace parts and germanium between successive pulls, as in multiple generation growth, is eliminated. By means of low temperature Hall and axial resistivity profile measurements, the segregation of both donors and acceptors was followed in various stages of growth. The normal segregation of impurities and the presence of a continuous impurity background source within the system were observed. (auth)

6663 ENCAPSULATION OF HIGH-PURITY GERMANIUM DETECTORS. Armantrout, G. A.; Wichner, R.; Swierkowski, S. P. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 344-346(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The encapsulation of high purity germanium detectors is very desirable in order to increase their versatility and reliability. However, rapid and extensive degradation is seen for all detectors made from detector grade crystals which are encapsulated in a simple vacuum. Extensive studies have shown that the cause of this degradation is hydrogen adsorption on the detector surface. There it causes the formation of a strong p+ inversion layer which in turn shunts the detector junction. Reliable encapsulation is shown to be achievable by the use of hydrogen-free germanium crystals. (auth)

6664 SURFACE EFFECTS ON P TYPE HIGH PURITY GERMANIUM DETECTORS AT 77°K. Baertsch, R. D. (General Electric Corp., Schenectady, NY). Contract AT(11-1)-3193. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 347-359(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Ellipsometry was used to measure the thickness of the residual film on the germanium surface after etching. Residual film thicknesses of 4 Å, 20 Å and 500 Å were obtained for the 10:1, 3:1 and 1:10 etches, respectively. A single detector was processed a total of 63 times using a variety of surface treatments. This study showed high breakdown voltage could be obtained with a variety of etches, but that the time the detector remains in the quenching solution should be minimized. The edge of the depletion region was scanned with a collimated 60 kV γ source after each surface treatment. The two scan results that could reproducibly be obtained were the type C, obtained with a 3:1 or 10:1 etch, a water quench, a brief evacuation and a rapid cool down, and the type B obtained using the same procedure with a 1:10 etch. The type C scan can be eliminated by heating in vacuum and restored by exposure to room air suggesting that it is caused by water vapor adsorbed on the surface. The type C scan is believed to result from hole trapping at the surface of the depletion region. An external electric field was used to increase the breakdown voltage of the detector. (auth)

6665 EFFECT OF EXPOSURE TO VARIOUS GASEOUS ENVIRONMENTS ON THE SUBSEQUENT PERFORMANCE OF HIGH PURITY GERMANIUM GAMMA RAY DETECTORS. Geleznias, V. L. (General Electric Co., Philadelphia). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 360-369(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Prior exposure to certain gases appears to largely determine the subsequent performance at LN_2 temperatures of high purity germanium detectors with exposure temperature being a critical factor. These gases are hydrogen, water vapor and possibly oxygen. An optimum concentration of water vapor in the environment to which the detectors are exposed prior to cool down appears to be essential to achieving good performance and stable operating characteristics. (auth)

6666 INCREASING THE RELIABILITY OF FABRICATION AND HANDLING OF LARGE HIGH PURITY GERMANIUM DETECTORS. Ewins, J.; Llacer, J. (Univ. of California, Los Angeles). Contract AT(04-1)Gen-12. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 370-373(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A technique has been developed in the fabrication of high purity germanium gamma radiation detectors which consistently allows the application of large amounts of overvoltage. A chemically grown oxide layer to which Pd metallization adheres strongly forms a rugged surface barrier. Cycling the temperature and cycling between dry nitrogen and ambient air, changing contact fixtures, storage, and transferring to different cryostats result in no significant changes in the initially good I-V and noise characteristics. (auth)

6667 MONOLITHIC GAMMA DETECTOR ARRAYS AND POSITION SENSITIVE DETECTORS IN HIGH PURITY GERMANIUM. Berninger, W. H. (General Electric Co., Schenectady, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 374-378(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

One dimensional monolithic arrays and position sensitive detectors have been fabricated in p-type high purity germanium. The results of collimated beam scanning measurements of array response and of energy and spatial resolution measurements in the position sensitive detectors are reported. Position sensitive detectors exhibiting 4.0 mm spatial resolution for 122 keV excitation have been fabricated and it is shown that position resolution improves with increased gamma ray energy. (auth)

6668 SURFACE BARRIER STRUCTURES WITH VARIOUS METAL ELECTRODES. Inskeep, C.; Elad, E.; Sareen, A. (ORTEC, Inc., Oak Ridge, TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 379-385(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The results of studies intended to provide a detailed understanding of the physical phenomena associated with dead layers sufficient to permit the production of rugged, reliable, ultrathin window detectors suitable for use in experiments which require the detection of very low energy radiation and also for the detection of heavily ionizing radiation, such as fission fragments, are described. The properties of contacts formed by several different metals have been investigated. Interesting phenomena were observed when using nickel and chromium as the rectifying contact. The thinnest dead layers obtained so far are 270 Å for gold, 280 Å for aluminum, and 190 Å for palladium, in terms of silicon-equivalence. (auth)

6669 PULSED OPTICAL AND ELECTRON BEAM EXCITATION OF SILICON POSITION SENSITIVE DETECTORS. Berninger, W. H. (General Electric Co., Schenectady, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 386-389(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Silicon two dimensional position sensitive detectors were fabricated by ion implantation and their response to pulsed electron beam and optical excitation was determined. The results of measurements of rise time, position resolution, linearity and current gain as a function of electron accelerating voltage are presented. It is shown that the gain-voltage curves are consistent with a model incorporating a thin (≈0.5 μm) dead layer at the surface of the detector. (auth)

6670 MOSFET DETECTOR EVALUATION. Ciarlo, D. R. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 390-394(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Metal-oxide-semiconductor devices have been evaluated as low-energy (250 eV to 50 keV) x-ray dosimeters. They can be used to measure dosages as low as 1 rad (SiO_2) to as high as 10^5 rad (SiO_2). Their small size and basic simplicity make it possible to form arrays of dosimeters for x-ray imaging. When compared to thermoluminescent dosimeters (TLD's), photographic film, and thermopiles, MOSFET dosimeters offer distinct advantages in terms of their small size, their sensitivity to photon energies below 10 keV, and their adaptability to an electrical readout system. (auth)

6671 DEVELOPMENT OF SILICON DETECTORS FOR THE MARYLAND ELECTROSTATIC ENERGY-CHARGE ANALYZER. Gigante, J. R.; Lundgren, R. A. (Univ. of Maryland, College Park).

IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 395-403(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Rectangular, 100μ thick surface barrier, and 1 mm thick lithium-drifted-silicon surface barrier detectors have been developed for the University of Maryland Electrostatic Energy-Charge Analyzer on the IMP H and J satellites. Fabrication techniques are discussed which influence detector properties such as injecting contacts, windows, trapping, and n- and p-type surfaces. Aspects of detector reliability, the selection of flight detectors, and some causes of detector failure are considered. (auth)

6672 ADVANCES IN CdTe GAMMA-RAY DETECTORS. Serreze, H. B.; Entine, G.; Bell, R. O.; Wald, F. V. (Tyco Labs., Inc., Waltham, MA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 404-407(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Performance of halogen-doped CdTe gamma-ray detectors has been improved significantly by the development of new device fabrication methods. In particular, these detectors do not exhibit any of the previously observed polarization effects. Room temperature resolution of 7% at 122 keV has been achieved using applied fields of less than 50 V/mm for detectors up to 100 mm^3 in volume. (auth)

6673 INSTRUMENTATION AND ENVIRONMENTAL RADIATION ASSESSMENT SYSTEMS. Peters, C. W. (Environmental Protection Agency, Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 470-477(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Information derived from environmental radiation monitoring is required to assess the compliance status, guide the development, and measure the progress of programs addressed to the overall problem of radiation protection. Monitoring techniques and requirements of instrumentation needed to cost-effectively implement environmental radiation monitoring systems are discussed. (auth)

6674 HIGH SPACIAL RESOLUTION CdTe MEDICAL PROBES. Entine, G. (Tyco Labs., Inc., Waltham, MA); Serreze, H. B.; Garcia, D. A. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 726-730(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

By taking advantage of the good energy resolution of CdTe detectors, gamma rays scattered by lead collimators can be rejected leading to excellent spacial resolution for medical probes. Since CdTe has over 100 times the photoelectric stopping power of Si at 140 keV (^{99m}Tc), the probe provides enough sensitivity that dental abscesses on the individual root tips of test animal teeth can be detected weeks before they are evident by radiographs. (auth)

6675 WINDOWLESS Si RADIATION DETECTOR AND BIOMEDICAL TELEMETRY SYSTEM FOR STUDYING THE FUNCTION OF ORGANS OF FREE-RANGING ANIMALS. Kobayashi, T. (Toshiba Research and Development Center, Kawasaki, Japan); Sugita, T.; Sasaki, T.; Iwase, T.; Sassa, R.; Iio, M. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 735-740 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A windowless silicon radiation detector and biotelemetry system has been developed and used in the study of the function of organs of free ranging animals. The system consists of an implantable silicon radiation probe, a transmitter package, an FM receiver, and a data handling unit. The intensity of radioisotopes (RI) taken in the organs is measured continuously with an implantable probe with a 5 mm diameter sensitive area. The transmitter package is composed of an RI signal conditioner, and a transmitter. The prototype transmitter package is made of aluminum, and 2 × 6 × 9.5 cm in size. With electronic components included, it weighs 170 gm. The power consumption of the transmitter is about 100 mW, and is furnished from three 5 V mercury batteries. Two of them are used as the detector bias supply. The system was made of discrete electronic components because of their better reliability, lower operating voltage, and lower power consumption. The fundamental characteristics and field performance of the system were carried out using several dogs with the aid of radioisotopes. The application of the system to the study of liver metabolism of dog is discussed. (auth)

6676 FIELD MEASUREMENT OF CESIUM-137 IN DEER. McMahan, J. W.; Wright, C. N. (E. I. du Pont de Nemours and Co., Aiken, SC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 513-516(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The U. S. Forest Service conducts yearly white-tailed deer hunts on the Savannah River Plant to help control the indigenous deer population. Successful hunters are permitted to retain their quarry after clearance by Forest Service personnel. To be sure that carcass radioactivity is similar to that found throughout the southeastern coastal region, each carcass is radioassayed on the spot with a single channel analyzer set to measure the cesium-137 photopeak. The circuitry and performance of the instrument used for the field analyses is described. A sodium iodide crystal with photomultiplier tube provides electrical pulses proportional to the incident gamma radiation. An amplifier is tailored to compensate the temperature-induced gain changes of the detector system, and micropower digital logic is used to form control, pulse shaping, and scaling functions. The components are interconnected with wire-wrap techniques. The resulting instrument is compact and simple to operate, and its analyses are comparable in accuracy to laboratory analyses. (auth)

6677 CAMAC SYSTEM FOR THE AUTOMATIC TESTING OF PHOTOMULTIPLIER TUBES. Burley, A. C. (Nuclear Enterprises Ltd., Reading, Eng.); Tothill, H. A. W. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 912-918(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The requirements of a dual multi-channel analyzer system for use in the production testing of photomultiplier tubes are detailed. How the system was effected by use of a CAMAC series of modules used to route data between the measurement facilities and a minicomputer and how the computer program was designed to control the acquisition and provide a rapid visual record of the performance of each tube in order to increase the production testing throughput are described. (auth)

6678 COMPUTER PROGRAM FOR CALCULATION OF RADIOACTIVITY DATA OBTAINED IN LIQUID SCINTILLATION SPECTROMETER WITH EXTERNAL STANDARD AND SINGLY OR DOUBLY LABELLED SAMPLES. Sliwowski, J.; Wozniakowska, G. (Univ., Warsaw). Rocz. Chem.; 47: No. 11, 2151-2157(1973).

Two computer programs written in ALGOL for the calculation of quenching corrections for labeled compounds are presented and discussed. Calculations were made on samples labeled with a single radioisotope, mixed samples of substances labeled singly with different radioisotopes, and samples doubly labeled with different isotopes (^{14}C and ^{3}H) on the basis of cpm measurements for the samples analyzed and for a series of ^{14}C and ^{3}H standards with known radioactivity and various quenchings. (JGB)

6679 GRADUATION OF DOSIMETERS WITH SOLID DETECTORS. Astakhova, I. V.; Shirmer, E. V. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 19: No. 4, 80-83(Apr 1974). (In Russian).

The effect of the spectral composition of x-rays on the sensitivity of semiconductor detectors and thermoluminescent dosimeters for x-ray detection is studied. (auth)

6680 PULSE COUNTERS FOR NUCLEAR PHYSICAL MEASUREMENTS. Sztaricskai, T. (Kossuth Lajos Tudomanyegyetem Kiserleti Fizikai Intezete, Debrecen, Hungary). ATOMKI (At. Kut. Intez.) Kozlem.; 16: No. 1, 1-12(1974). (In Hungarian).

Four different decimal pulse counters constructed for nuclear measurements are described. The counters differ both in set-up and supply because of the different experimental conditions. The KFI 7106, a simple six decade counter, serves for built-in and general purposes. The KFI 7209 counter is a multi-purpose one, with six operational modes. The KFI 7305 counter is a simple up or down counter with LED display. In the ratemeter mode both the KFI 7209 and the KFI 7305 can be controlled by the KFI 7301 counter-generator. The KFI 7301 is a displayless five decade preset counter-timer, producing a preset number of pulses or variable frequency square waves. (auth)

6681 APPLICATION OF MULTIWIRE PROPORTIONAL CHAMBERS IN MICRODOSIMETRY. Krueger, E. H.; Rimpl, G. (Univ., Munich). Biophysik; 10: No. 4, 299-308(Dec 1973). (In German).

Multiwire proportional chambers (MWPC) have been developed in high-energy physics. The basic theory of the MWPC and the theory of gas amplification for high values of E/p are used to investigate the possible use of MWPC in microdosimetry. It is shown by theoretical examples that for certain dimensions of a MWPC a zone of electron drift and a separate zone of gas amplification can exist. Thus a local resolution for ionization events

occurring in the drift zone can be obtained. With the experimental set-up it was possible to vary the important parameters of a MWPC. The existence of an electron drift zone and a separated gas amplification zone could be shown. The pulse height spectra were used to estimate the dimensions of the drift zone. These estimates are in agreement with the theoretical computations. (GE)

6682 MONITORING SYSTEMS FOR RADIOACTIVE AEROSOLS. Gebauer, H. (Frieseke und Hoepfner G.m.b.H., Erlangen, Ger.). Atomwirt., Atomtech.; 19: No. 2, 81-85(Feb 1974). (In German).

For the detection of radioactive aerosols, the air to be controlled is drawn through a high refining filter, on and in which the aerosols are refined. Such an enrichment of aerosols is necessary to measure the permissible activity concentration. A system of standardized units was developed that covers all practical cases of application. This system allows an integral or spectrometric measurement as well as an analogue or digital registration of measured values. Besides a systems description, the lower detection limit of the smallest activity concentration is demonstrated numerically. (GE)

6683 TEMPERATURE-DEPENDENT PROBABILITY OF NUCLEAR-EMULSION GRAINS. Singh, M. (Government Higher Secondary School, Kurukshetra, India). Indian J. Pure Appl. Phys.; 11: No. 6, 426-427(Jun 1973).

A relation for the probability of development (π) of AgBr grains in nuclear emulsions has been derived taking into account its temperature dependence. The theoretically evaluated values of π are found to be in agreement in the temperature interval 0 to 18°C with the experimental observations. The values of π become independent of temperature for heavy specific ionizations. (auth)

6684 YIELD STABILIZATION OF SCINTILLATION SPECTROMETERS. Seda, J.; Sabol, J. (Fakulta Jaderna a Fyzikalne Inzenyrska, Prague). Radioisotopy; 14: No. 5, 715-781(1973). (In Czech).

A scintillation detector system is discussed with respect to the stability of its individual parts. The existing possibilities of stabilization of scintillation spectrometers are discussed and an improved connection of the stabilization unit is suggested. (63 references) (auth)

6685 SPATIAL DISTRIBUTION DETERMINATION OF A BREMSSTRAHLUNG BEAM BY THE ACTIVATION METHOD. Vaivads, Ya. K. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 1, 3-6(1974). (In Russian).

A procedure for determining the spatial distribution of a bremsstrahlung beam ($E_{e^-} = 4$ MeV) by activation $^{115}In(\gamma,\gamma')^{115m}In$ is described. Gamma quantum fluxes are calculated from the total absorption peak in ^{115m}In emission spectra and their distributions are given. (auth)

6686 DETERMINATION OF RADON IN AIR. Auxier, J. A.; Perdue, P. T.; Shinpaugh, W. H.; Thorngate, J. H. (to United States Atomic Energy Commission). US Patent 3,805,070. 16 Apr 1974. Filed date 6 Jul 1973. 6p.

A device and method for measuring the amount of radon present in air are described. A silicon diode detector system operates in helium at atmospheric pressure, and an alpha spectrum is obtained that can be analyzed for the radon activity. The invention facilitates radon concentration measurements in the many widely scattered localities in the biosphere where these measurements are of interest, such as in uranium mines, coal mines, and in the lower atmosphere. (Official Gazette)

6687 NOBLE GAS SCINTILLATOR FOR MEASURING NEUTRON FLUX. Carroll, E. E. Jr. (to United States Atomic Energy Commission). US Patent 3,805,076. 16 Apr 1974. Filed date 8 May 1973. 2p.

For measuring neutron flux in a power reactor, a long slender gas-containing tube is built into the reactor. The tube acts as a light pipe for scintillations from a secondary gas mixed with the first noble gas. The secondary gas produces a charged particle upon absorption of a neutron, which particle passes through the noble gas causing the emission of ultraviolet radiation. The tube is viewed from the upper open end by a photomultiplier. A variety of secondary gases may be used for neutron spectrum analysis and the device may also be used as a gas pressure thermometer. (Official Gazette)

6688 DIRECT CALCULATION OF THE COLLIMATOR TRANSFER FUNCTION FOR SINGLE BORE AND MULTICHANNEL FOCUSING COLLIMATORS. Barber, D. C. (Weston Park Hospital, Sheffield, Eng.). Int. J. Appl. Radiat. Isotop.; 25: No. 5, 193-202(May 1974).

A method of directly calculating the collimator transfer function (CTF) of both single bore and multichannel focusing collimators is presented. Since the point function (PSF) of a single hole collimator is obtained by the cross correlation of the exit pupil and the projection of the entrance pupil plane, the CTF may be obtained directly from the cross correlation theorem, by a product of the Fourier Transform of the exit pupil and a suitably scaled Fourier Transform of the entrance pupil. The method is extended to multichannel focusing collimators and examples are given. (auth)

6689 NEUTRON MEASUREMENT ASSEMBLY WITH WIDE DYNAMIC RANGE. Plaige, Y. (CEN de Saclay, Gif-sur-Yvette, France); Mai, V. Q. Kerntechnik; 16: No. 1, 28-29(Jan 1974).

The combination of pulse and fluctuation measurements makes it possible to obtain a wide range of measurements (ten decades), using a single detector (fission chamber). These two measurement methods also have the common advantage of offering good neutron-gamma discrimination. This wide dynamic range instrumentation is advantageous on account of its simplicity and the economy in reactor control. All detectors and electronic subassemblies have been tested and are available for industrial service. (GE)

6690 CORRECTING FOR EMISSION-TIME EFFECTS IN NEUTRON TIME-OF-FLIGHT DATA USING MULTIPLE TIME SPECTRA. Robitaille, H. A.; Hewitt, J. S. (Univ. of Toronto). Nucl. Sci. Eng.; 54: No. 2, 143-156(Jun 1974).

An analytical method was developed whereby neutron time-of-flight spectra may be corrected for emission-time dispersion without requiring a priori knowledge of the source time distribution or employing time-dependent spectral measurements. The method relies on time-of-flight spectra only, obtained experimentally at several flight-path distances, rather than the customary measurement at a single detector position. (15 figures) (auth)

6691 PROCEDURE AND DEVICE FOR RADIOCHROMATOGRAPHY. Asard, P. E. (to AGA Aktiebolag). US Patent 3,803,404. 9 Apr 1974. Filed date 16 Aug 1971. 4p.

A radiochromatographic procedure for analyzing a substance having a gamma-radiating isotope added to it using a spark chamber with a cathode surface, a grid and an anode is described. The sample of said substance is put on a chromatographic plate, placed on the cathode surface, and used as an electron emitting cathode, said electrons being composed of emitted beta-radiation from gamma decay and of Auger- and conversion electrons. The isotope atoms which are bound in the substance or possible free isotope atoms, which migrated from the substance, are detected by means of the spark chamber so as to establish the distribution and the concentration of the isotope atoms in the substance. (Official Gazette)

6692 DEVICE WITH A DIAMOND DETECTOR FOR NEUTRON DETECTION. Kozlov, S. F. (to Fizichesky Institut Imenia P. N. Lebedeva Akademii Nauk USSR). US Patent 3,805,078. 16 Apr 1974. Priority date 3 Oct 1968, USSR. 6p.

A device for neutron detection, comprising in combination with a radiator, a nuclear radiation detector on the basis of a diamond crystal plate with contacts formed at the opposite sides is described. One of the contacts is made blocking in relation to charge carriers and is provided with the radiator, while the opposite contact is made of a material capable, in conjunction with diamond, of injecting charge carriers under the influence of an applied electric field. (Official Gazette)

6693 IMAGE-DISSECTING CHERENKOV DETECTOR FOR IDENTIFYING PARTICLES AND MEASURING THEIR MOMENTUM. Roberts, A. (to United States Atomic Energy Commission). US Patent 3,805,075. 16 Apr 1974. Filed date 13 Mar 1973. 10p.

Charged atomic and subatomic particles in a beam are classified as a type and momentum range by a detector having a beam bender, a Cherenkov medium and a segmented optical system for generating electrical pulses corresponding to illumination of predetermined regions of Cherenkov circles. Analysis of the illuminated regions by electronic logic provides identifying signals for given particles and given ranges of momentum. (Official Gazette)

6694 PROGRAMMING APPARATUS FOR AN AUTOMATIC RADIOACTIVITY COUNTING SYSTEM. Frank, R. B. (to Nuclear-Chicago Corp.). US Patent 3,805,071. 16 Apr 1974. Filed date 8 May 1972. 12p.

A sample group programming apparatus including a binary coded program indicating plug mounted over a first-to-be-counted sample in a sample group and reading apparatus positioned relative to the sample transfer station for liquid scintillation counting is described. A binary coded disc and light conducting arrange-

ment on a support member comprise the program indicating plug and a light source and a number of light responsive elements comprise the reading apparatus. (Official Gazette)

6695 SLOTTED COAXIAL GERMANIUM GAMMA-RAY CAMERA. Strauss, M. G. (to United States Atomic Energy Commission). US Patent 3,803,416. 9 Apr 1974. Filed date 28 Nov 1972. 12p.

An image is obtained of a radiation emitting object using a coaxial germanium semiconductor detector which includes an N-type-semiconductor peripheral region axially separated into a plurality of N-type-semiconductor region segments, a P-type-semiconductor core region and an intrinsic semiconductor center region between the N-type-peripheral and P-type-core regions. A pinhole collimator surrounds the coaxial detector to collimate the radiation from the object to impinge on the surface of the detector in the axial direction of the detector. A bias voltage is applied between each N-type region segment and the P-type core region of the detector. A preamplifier, amplitude discriminator, and a signal encoder are serially connected to each of the N-type segments to measure output signals therefrom responsive to the incidence of the radiation on the detector and thereby provide a binary readout of the angular position of incidence of the radiation. A pulse-shape analyzer and analog-to-digital converter are serially connected to the P-type core of the detector to provide a binary readout of signals corresponding to the radial position of incidence of radiation on the detector. A computer associates and combines the polar radial and angular positional data of the radiation on the detector into Cartesian coordinate signals which are applied to an oscilloscope for an image display of the object. (Official Gazette)

6696 GEOMETRICAL DETECTION EFFICIENCY OF POINT AND DISC SOURCE. Matsui, Y.; Furuta, T. (Government Industrial Research Inst., Nagoya, Japan). Radioisotopes (Tokyo); 22: No. 12, 681-689(Dec 1973). (In Japanese).

The geometrical efficiencies of radiation detection from a point and a disc source by a detector with a circular window were calculated by a polynomial expression. These were also calculated in the case of a source off the center line of the detector window. It was found that the geometrical efficiency G_p of a point source at a point P(x,z) off the center line, in the case of $z \geq 5$ A, can be approximately expressed as: $[G_p/G_0 = 1.0 - 1.54\,(x/z)^2 + 0.89\,(x/z)^3]$, where $[G_0 = \frac{1}{2}\,(1.0 - (D/z)]$: geometrical efficiency of a point source on the center line. The geometrical efficiency G_s of a disc source (radius R) on the center line, in the case of $z \geq A$, can be approximately expressed as: $[G_s/G_0 = 1.0 - 0.84\,(R/z)^2 + (R/z)^3]$ where A is the radius of the detector window. (auth)

6697 CHARACTERISTICS OF NaI DETECTORS WITH AN UNFOCUSSED RECTANGULAR SLIT COLLIMATOR. Nishizawa, K.; Tamiya, T. (Nagoya Univ., Japan). Kaku Igaku; 10: No. 6, 531-537(Dec 1973). (In Japanese).

A NaI detector with an unfocused rectangular slit collimator is often employed in quantitative measurement of radionuclide distribution in the human body for the purpose of internal absorbed dose calculation. Two characteristics of this collimator-detector system were studied: (1) resolution along the body axis and (2) relative counting efficiency within the axial transverse section. The point spread function was calculated from the geometrical configuration of the collimator-detector system and compared with the experiment. It was found that the experimental point spread function was well fitted by the Gaussian function but does not agree with the calculated one. The relative counting efficiency in a transverse section was calculated for circular cross section in water phantoms of several different diameters and also compared with experimental results under similar geometric conditions. Results of the calculation and the experiment are in good agreement. From these results, it may be concluded that this type of collimator is useful for quantitative assessment on the depth dependence of the resolution. (auth)

6698 LOW-BACKGROUND BETA COUNTING ARRANGEMENT. Gyoenyoer, B. (Technical Univ., Budapest). Acta. Phys. Acad. Sci. Hung.; 35: No. 1-4, 131-139(1974).

An improved low-background counter suitable for the measuring of beta samples is described. For eliminating the background radiation, a liquid scintillation detector was used. The anticoincidence stage was carried out by diodes. The results of a series of measurements indicated a background rate of 0.3 pulses/minute. (auth)

6699 LOW-BACKGROUND, VERY SENSITIVE ALPHA SCINTILLATION CHAMBER FOR THE DETERMINATION OF RADON AND RADIUM. Endre, S. (Radiation Protection Lab., Targu-Mures, Romania). ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 3, 217-224(1973). (In Hungarian).

A new alpha-scintillation counter was designed and built to measure the Rn and Ra content of natural waters. The studies revealed that a water sample of about 200 to 250 ml is needed for the determination; this implied a 300-ml Curie type container with a free gas space of 50 to 100 ml. The chamber used consisted of a cylinder with a diameter of 101 mm, a volume of 1113 ml and a surface of 590.1 cm^2 made of highly polished stainless steel. The bottom and top were made of Plexiglas which was found to be preferable to glass because the latter may contain alpha-active impurities. The scintillation phosphor consisted of ZnS(Ag), applied at a thickness of 10 mg/cm^2 and operated with a C. Zeiss Jena photomultiplier. The device had a sensitivity of $2 \cdot 10^{-13}$ Ci of ^{222}Rn at a discrimination voltage of 5 V and a channel width of 1 V at a multiplication of 100×. The efficiency was 26.0 per cent at a background of 5 to 6 pulses per hour. (TTT)

6700 CHOICE OF A DETECTOR FOR INVESTIGATION OF AN INACTIVE TAG. Tkachenko, V. I.; Soshin, L. D.; Schekin, K. I. (Inst. of Medical Radiology, Erevan). Med. Radiol.; 19: No. 5, 69-74(May 1974). (In Russian).

The criteria for the assessment of detector parameters in the investigation with an inactive tag based on excitation of fluorescent x-rays are discussed. On the basis of these criteria, the parameters of scintillation, proportional, and semiconductor detectors are analyzed. A comparison of different detectors of radiation was made according to energy resolution. The authors characterized the relation between registration efficiency for scintillation counters and different sizes of the crystal and for proportional counters i.e., different filling and design. Iodine spectra in aqueous solution for scintillation, proportional, and semiconductor detectors are shown. (auth)

6701 DESIGN OF A RADIATION FIELD PARAMETER INDICATING SYSTEM. Jehmlich, H.; Jappe, D. (Technische Univ., Dresden). Isotopenpraxis; 10: No. 2, 71-73(Feb 1974). (In German).

The specifications of a display system for radiation field parameters are outlined. The design and construction of this system are described, and a block diagram is given. (JSR)

6702 ELECTRIC CIRCUIT FOR CONVERSION OF PULSE SIGNALS FROM GEIGER-MUELLER COUNTERS TO DIRECT CURRENT VOLTAGE. Gunka, K. Czech Patent 146,219. 15 Nov 1972. 3p. (In Czech).

An electric circuit is described designed for the conversion of pulses from Geiger-Mueller counters to dc voltage, proportional to the pulse rate of the pulse signal. The positive terminal of the power supply is connected via a resistor to the first capacitor, to the thyristor anode, and to the positive terminal of the Geiger-Mueller counter. The negative electrode of the counter is connected to the control electrode of the thyristor and via the resistor to the thyristor cathode, respectively. The cathode of the thyristor is connected, via a resistor, to the second electrode of the first capacitor and via a resistor connected in parallel to the second capacitor, to the negative terminal of the power supply. (INIS)

6703 WIDE RANGE NEUTRONIC MEASUREMENT EQUIPMENT. Plaige, Y. (CEN de Saclay, Gif-sur-Yvette, France); Mai Vuong, V. Q. Ind. At. Spatiales; 17: No. 5, 30-34(Sep 1973). (In French).

A fission chamber can be used for both pulse and fluctuation measurements on neutron fluxes. These two techniques are complementary, the first being used for low levels of neutron flux and the second being used for high levels of neutron flux. Both have high neutron-γ discriminating powers. A unit was constructed using a single fixed position detector for both types of measurement. In this way, a wide band measurement range (10 decades with two overlapping decades) was achieved. The unit provides flux measurements on a logarithmic scale, period measurements throughout the entire range, and current measurements. This instrumentation has been extensively reactor tested and is at present being developed on the industrial scale. (FR)

Radiation Dosimeters

6704 LARGE AREA REACH-THROUGH AVALANCHE DIODES FOR RADIATION MONITORING. Webb, P. (RCA Victor Co. Ltd., Montreal); Jones, A. R. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 151-158(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Avalanche diodes, up to 20 mm^2 in area, have been made with sensitivities up to 6×10^8 counts/Roentgen. Operating at 200 volts, typical gains of 20 are achieved. This permits the detection of

6 keV x-rays and dosimetry of gamma rays down to 30 keV with background counting rates of about 0.1 c/s. (auth)

6705 ESTIMATION OF GAMMA-RAY EXPOSURE IN MIXED GAMMA-NEUTRON FIELDS BY ^{6}LiF AND ^{7}LiF THERMOLUMINESCENCE DOSIMETERS IN PAIR USE. Tanaka, S. I.; Furuta, Y. (Japan Atomic Energy Research Inst., Tokai). Nucl. Instrum. Methods; 117: No. 1, 93-97(1974).

A procedure to estimate gamma-ray exposure in mixed gamma-neutron fields using a pair of ^{6}LiF and ^{7}LiF thermoluminescence dosimeters is described. In this method, only the "shape" of neutron spectrum is sufficient to know the exposure. Three types of neutron spectrum, i.e. monoenergetic, 1/E and fission, are investigated for the application. (auth)

6706 RESPONSE OF $CaSO_4$(Dy) PHOSPHOR TO NEUTRONS. Weng, P. S.; Chen, K. M. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Instrum. Methods; 117: No. 1, 89-92(1974).

Several batches of $CaSO_4$(Dy) phosphor were prepared for the investigation of the thermoluminescent response versus thermal- and fast-neutron fluence at low dose level in a mixed neutron-gamma field from Pu-Be neutron source. The $CaSO_4$(Dy) phosphor was homogeneously mixed with various quantities of B_2O_3. The phosphor mixtures were prepared in such a way that the boron content was 0, 1 and 3 wt %, respectively. The fast-neutron dosimeter system required two capsules of phosphor. One of the capsules was filled with the $CaSO_4$(Dy) only, for the measurement of gamma radiation; the other was filled with both $CaSO_4$(Dy) and alcohol for the measurement of gamma and neutron radiation. The results of these two measurements were subtracted to obtain the fast-neutron response with a detection limit of 5×10^5 n/cm^2. (auth)

6707 MEASUREMENT OF LOW LEVEL ENVIRONMENTAL γ DOSES WITH TLDS AND GEIGER COUNTERS. Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 456-460 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Environmental monitoring using a complementary system of TLDs and Geiger counters is described. The inexpensive TLDs give integral dose data at many points in the surveillance area, while the Geiger counter instruments, though more expensive, allow measurement of smaller doses and show changes of dose rate with time at points of particular interest in the vicinity of nuclear facilities. (auth)

6708 PERFORMANCE CRITERIA FOR ENVIRONMENTAL RADIATION MONITORING WITH TLD SYSTEMS. Burke, G. de P.; McLaughlin, J. E. (Atomic Energy Commission, New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 444-450(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Guidance to the selection, laboratory evaluation, and application of TLD systems for routine environmental radiation monitoring is presented. Methods are discussed for performing initial and routine evaluations to assure that required accuracy and reliability is achieved and maintained. A typical environmental measurement made with a commercial system is examined to illustrate the effects of the various parameters and techniques considered. Methods for separating total radiation exposure measurements to isolate its components, notably that attributable to the gaseous effluent from a nuclear facility, are discussed. (auth)

6709 THIN FILM RADIATION DOSIMETER SYSTEM. Little, R. G.; Kime, M. B. (Simulation Physics, Bedford, MA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 817-821(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A laser based optical densitometer system has been developed for scanning thin film dosimeters (T.F.D.'s). The system utilizes a laser beam whose wave length occurs in the maximum optical attenuation spectral range of the dosimeter film dye. A split beam comparitor technique allows accurate determination of radiation induced changes in the dosimeter film optical density. (auth)

6710 TEMPERATURE-COMPENSATED ELECTROMETER FOR ENVIRONMENTAL MEASUREMENTS. Negro, V. C.; Watnick, S.; Raft, P. (Atomic Energy Commission, New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 805-811(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

An electrometer which uses a single MOSFET as the current-detecting and temperature-compensating element for use with ionization chambers is described. The input drift is less than 3×10^{-15} A from -20°C to $+40$°C. This electrometer is used in radiological field instruments which have been operating continuously for over a year. It can resolve changes down to 0.1 μR/hr (2.5×10^{-15} A) in a background exposure rate of 6-10 μR/hr. (auth)

6711 THERMOLUMINESCENT LITHIUMBORATE GLASS FOR CLINICAL DOSIMETRY. Khva, L. D.; Mandel'tsvaig, Yu. B. (All-Union Scientific-Research Inst. of Medical Instruments, Moscow). Med. Radiol.; 19: No. 5, 66-69(May 1974). (In Russian).

Dosimetric characteristics of thermoluminescent detectors with a low effective atomic number on the basis of lithiumborate glass were studied including dependence of the signal upon radiation dose in the therapeutic dose range, energy dependence in the range of 20 to 125 keV, and loss of dosimetric information fading in the course of several months. The possibility of application of the detectors for the purpose of radiation therapy is discussed. (auth)

6712 THERMOLUMINESCENCE OF $SrSO_4$:Dy AND $BaSO_4$:Dy. Dixon, R. L.; Ekstrand, K. E. (Wake Forest Univ., Winston-Salem, NC). Phys. Med. Biol.; 19: No. 2, 196-205(Mar 1974).

The thermoluminescence of $SrSO_4$ and $BaSO_4$ doped with dysprosium and thulium was studied. The phosphors were crystallized from H_2SO_4 solution by evaporation. $SrSO_4$:Dy and $SrSO_4$:Tm exhibited the same glow curve, both having a major glow peak at 140°C. $BaSO_4$:Tm also exhibited identical glow peaks at 130°C, similar to the $SrSO_4$ peaks except for the small shift in temperature. It is suggested that the glow peaks in these phosphors result from traps characteristic of trivalent rare earths, and the decrease in glow peak temperature as one goes from $SrSO_4$ to $BaSO_4$ is due to an increase in interatomic spacing alone (since these crystals have the same symmetry). The sensitivities of $SrSO_4$:Dy and $BaSO_4$:Dy (glow peak height per mole) relative to $CaSO_4$:Dy (Harshaw) were 90 and 27%, respectively, for ^{60}Co irradiation. The emission spectra of both phosphors consisted of two sharp peaks at 478 and 568 nm which could be identified as the $^4F_{\frac{9}{2}} \rightarrow {}^6H_{\frac{15}{2}}$ and $^4F_{\frac{9}{2}} \rightarrow {}^6H_{\frac{13}{2}}$ transitions in the Dy^{3+} ion. The following dosimetric properties of these phosphors were also measured: fading, linearity with dose and response versus photon energy. $SrSO_4$:Dy appeared most suitable for dosimetry; particularly as a quality indicator for personnel dosimetry. Its behaviour from 100 mR to IR was, however, somewhat nonlinear. (auth)

6713 DIGITAL VOLTMETER PLUG-IN MODULE FOR THE RADOCON 555 WHICH IMPROVES LINEARITY. Dixon, R. L. (Wake Forest Univ., Winston-Salem, NC). Phys. Med. Biol.; 19: No. 2, 206-209(Mar 1974).

An outline description is presented of a plug-in digital voltmeter module, which can be used interchangeably with the "timer-trip" plug-in module, and which requires negligible internal modification of the Victoreen Model-555 Radocon integrating dose rate meter. The module is based on a Hewlett-Packard 3431 A panel DVM and increased the precision of the Radocon 555 by at least a factor of 10. The response of the panel meter with exposure was measured using a succession of single irradiations of 1 min duration on a ^{60}Co teletherapy unit. The meter reading was linear with exposure within 0.2% over a decade. (UK)

6714 COMPARISON OF DOSIMETRIC METHODS USED IN ENVIRONMENT. Nakashima, Y.; Aoki, T. (Nagoya Univ., Japan). J. Nucl. Sci. Technol. (Tokyo); 11: No. 1, 15-21(Jan 1974).

Based on requirements in health physics and radiation protection, a study was made of the accuracy and sensibility of different practical methods utilized in dosimetry. The ionization chamber, the NaI true spectrum method, the method relying on the proportional counter, and soil sampling, were applied to measurements in various environments and in constant radiation fields. The first three techniques yielded results agreeing quite well with each other in a field of constant exposure rate. The results obtained with soil sampling, using a Ge(Li) measuring system indicated that the small amount of ^{137}Cs radionuclide remaining in the soil tended to give values somewhat higher than given by other methods. The small difference in incident radiation entering a detector between one placed in the natural environment and one shielded with thin concrete could be distinguished by the NaI true spectrum method. The method utilizing the proportional counter also gave quite good results considering its small effective volume. In respect to both accuracy and sensibility, it is concluded that the NaI true spectrum method is the best among the techniques. (auth)

6715 CHARGING OF RADIOACTIVE RADIATION DOSEMETER. Fronka, O.; Moucka, L.; Pavlicek, Z.; Cernavsky, J. Czech Patent 145,736. 15 Oct 1972. 2p. (In Czech).

A method for charging a dosemeter operating on the principle of discharging a capacitor is described, i.e., of charging the capacitor of the dosemeter to operating potential. Mechanical movement of a friction segment against the electrode of the charging capacitor or against a surface connected to it results in the charging of the capacitor electrode. The charged capacitor is then connected to the inner electrode of the dosemeter capacitor. The connection only lasts until the capacitor of the dosemeter is charged to operating potential. (INIS)

6716 TEMPERATURE CONTROLLER FOR EXOELECTRON EMISSION MEASUREMENTS. Onuma, I. (Inst. of Physical and Chemical Research, Wako, Japan); Kirihata, F. Rikagaku Kenkyusho Hokoku; 49: No. 6, 194-199(Nov 1973). (In Japanese).

The design and features of an automatic temperature controller used for study of thermally stimulated exoelectron emission are described. It provides a range of heating rates of 0.2, 0.5, 1.0, 2.0 and 4.0°K/sec. A constant temperature is kept at will between 300 and 800°K. The variation of temperature is less than ±1°K. (auth)

6717 γ-RAY AND X-RAY DETECTOR USING INTEGRATION AND COUNTING. Kudelin, K. M.; Zabrodskaya, L. Ya.; Odintsov, V. P. Sov. J. At. Energy (Engl. Transl.); 34: No. 1, 42(Jan 1973). Translated from At. Energ. (USSR); 34: No. 1, 33(Jan 1973).

A detector is described whose sensitive element (a single crystal of lithium fluoride) is used in two ways: in an integrating mode (dose measurement), making use of thermoluminescence, and in a counting mode (dose rate measurement), making use of radioluminescence. The range of dose rate measurements is 0.1 to 100 R/min, and the range of dose measurements is 0.1 to 1000 R. In the 25 to 1300 keV energy range, the variation in sensitivity is no more than ±8%; this is achieved by partial shielding of the crystal. A design estimate of the filter parameters is given. The dose is calculated on the basis of the amplitude of the thermal peak, whose maximum at 140°C occurs 40 sec after the heater voltage has been turned on. At temperatures not exceeding 25°C the drop in the thermal-peak maximum is no more than 10% after 1 day and no more than 30% after 10 days. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 6776, 7448, 7529, 8489, and 8574.

6718 (JINR-P10-7822) COMMUTATOR OF RANDOM SIGNALS. Barabash, I. P.; Shibaev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 10p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A commutator for random signals is described which excludes the possible error in the signal recording when the signals coincide with the commuting pulses. Use of this method in the time coder allows one to abandon the detector signal phasing, increasing by this the speed of response of the coder. (auth)

6719 (LYCEN-7328) ENERGY RESOLUTION OF THE ELECTRONICS OF A SEMICONDUCTOR DETECTOR X-RAY SPECTROMETER UNIT. Stroback, H. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire). Jun 1973. 110p. (In French). Dep. NTIS (US Sales Only) $8.50. Thesis.

The theoretical and experimental considerations which led to the development of this semiconductor detector x-ray spectrometer unit are presented. The principles of x-ray fluorescence analysis are recalled. The various parameters determining the energy resolution of the unit are studied. The numerical calculations performed are more complex than those already published. The principles behind the measurement of the most important parameters (leak currents, input capacitance, figure of merit, and noise spectral density) are discussed. The work undertaken should facilitate the accurate determination of the resolution of existing units as well as the construction of new units with predetermined specifications, the various factors upon which the resolution depends being optimized. (FR)

6720 (RISO-M-1694) SIMPLE THERMOSTAT BASED ON A TEMPERATURE-REGULATED GAS STREAM. Andersen, E. B.; Fenger, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

The construction and performance of a thermostat of the gas-stream type are described. The thermostat was developed for Moessbauer measurements, but can equally well be used in connection with other types of spectrometry. In the present form it has been used in the temperature range −150 to +250°C, with a regulating sensitivity of ±0.5°C. (auth)

6721 (RISO-M-1695) DESIGN AND PERFORMANCE OF A MOESSBAUER RESONANCE COUNTER. Fenger, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

The design of a resonance counter for Moessbauer studies with iron-57 is described. Various applications in beam experiments, source experiments, and surface studies are discussed. (auth)

6722 SATELLITE-BORNE HIGH-RESOLUTION Ge(Li) GAMMA-RAY SPECTROMETER SYSTEM. Part 1. Description of the Instrument and Gamma-Ray Backgrounds in Earth Orbit. Nakano, G. H.; Imhof, W. L.; Johnson, R. G. (Lockheed Missiles and Space Co., Palo Alto, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 159-163(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Gamma radiation from terrestrial and extraterrestrial sources has been investigated for the first time with a high-resolution lithium-drifted germanium spectrometer-cryogen system flown on board a low-altitude, spin-stabilized, polar-orbiting satellite (1972-076B) launched on October 2, 1972. Gamma-ray pulses corresponding to energies between 40 keV and ~2.8 MeV are analyzed by a 4096-channel pulse-height analyzer with an overall system resolution of 3.5 to 4.0 keV FWHM (1.33 MeV ^{60}Co). A description of the instrument, its performance in earth orbit and preliminary results of the gamma-ray backgrounds are presented. (auth)

6723 Ge(Li) SPECTROMETER FOR GAMMA RAY ASTRONOMY. Hicks, D. B. (Ball Brothers Research Corp., Boulder, CO); Jacobson, A. S. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 169-177(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A space-borne instrument to measure the spectral and temporal characteristics of astronomical γ-rays in the 0.05 to 10 MeV energy range is described. The spectrometer consists of four 60 cc Ge(Li) detectors with an energy resolution of 2.5 keV (FWHM) at 1.33 MeV. The Ge(Li) detectors are actively shielded with CsI(Na) for angular collimation and background reduction. Cooling of the Ge(Li) detectors to 88°K for orbital lifetimes of up to two years is provided by a two-stage solid subliming refrigerator. (auth)

6724 SEMICONDUCTOR DETECTORS SETUP FOR NUCLEAR SPECTROSCOPY STUDIES. Bosch, H. E.; Davidson, J.; Farilli, M. A.; Silbergleit, V. (Univ. of Buenos Aires). Nucl. Instrum. Methods; 117: No. 1, 213-219(1974).

Two setups of semiconductor detectors were employed. For the detection of gamma rays, a commercial Ge(Li) counter was used. For the detection of low-energy x rays, internal conversion electrons, and beta continuum spectra, a Si(Li) counter was mounted in a cryostat, the configuration of which is given. Both detectors were used to study the decay of ^{115}Cd (53.5 h). New results are reported concerning the ICC, beta spectra and low-energy x-ray spectra. (auth)

6725 LOW-BACKGROUND Ge(Li) DETECTOR SYSTEMS FOR RADIOENVIRONMENTAL STUDIES. Camp, D. C.; Gatrousis, C.; Maynard, L. A. (Univ. of California, Livermore). Nucl. Instrum. Methods; 117: No. 1, 189-211(1974).

Two Ge(Li) detector systems designed to measure low-level radioenvironmental samples are described. The materials used in the construction of these systems and the effect of these materials on the background radioactivities are discussed. One system, designed to count mid-range specific activities, contains a closed, coaxial, 10% Ge(Li) detector that is housed in electrolytic magnesium and operated within a standard lead cave. Continuum background levels in this system vary from 0.1 c/min keV at 200 keV to 0.01 c/min keV at 1 MeV. The second system, designed for maximum sensitivity, contains a 15%-relative-efficiency Ge(Li) detector housed in electrolytic magnesium and operated in anticoincidence with a large plastic detector. This entire system is placed inside a lead- and steel armor plate shield located in a counting room below ground level. For single gamma-ray emitters from point sources, the maximum continuum suppression factor is greater than 8. Under suppression conditions the background continuum, as well as the usual contaminant peaks, are the lowest yet reported for Ge(Li) environmental counting systems. Continuum values decrease from about 6×10^{-3} c/min keV at 200 keV to less than 3×10^{-4} c/min keV at 1 MeV. A 1000 min count of 250 g of soil shows that this system can measure a ^{137}Cs specific activity of 20 fCi/g with a precision of 15%. The lowest specific activity per gram detectable in a one-week count under threshold conditions (±50%) for a single gamma-ray emitter with $E_\gamma > 500$ keV is several hundred aCi/g. (auth)

6726 PRECISION HALF-LIFE MEASUREMENTS USING Ge(Li) DETECTORS. Azuelos, G.; Crawford, J. E.; Kitching, J. E. (McGill Univ., Montreal). Nucl. Instrum. Methods; 117: No. 1, 233-238(1974).

Three correction methods for counting losses—a constant pulser, a proportional feed-back pulser and a pile-up rejector technique—have been examined in conjunction with a Ge(Li) detector and a slow electronic system. Computer simulations of multi-component, multi-sample half-life data indicate that the rejector method should be preferred over the pulser feed-back method for precision measurements. The latter technique is comparable if strict pulser proportionality to the half-life under investigation is maintained. Maximum accuracy is always obtained if each data sample is corrected for losses before summation to other data. Summing of several data sets before counting loss correction always introduces an error, unless the samples contain only one half-life component. The improper statistical analysis of accumulated data has been found to give rise to errors comparable in size to counting loss correction errors. It is found that a weighted mean anomaly must be considered, distinct from the logarithmic weighting effect described by Robinson. This effect is found to shift the apparent half-life a few standard deviations from the true half-life. Precision half-life measurements are reported for ^{19}C: (19.28 ± 0.02) s, ^{14}O: (70.43 ± 0.18) s, and ^{23}Mg: (11.26 ± 0.08) s. (auth)

6727 CONTINUOUS HIGH-FIELD OPERATION OF CdTe GAMMA DETECTORS WITH MIS-TYPE CONTACTS. Eichinger, P. (Univ., Munich); Halder, N.; Kemmer, J. Nucl. Instrum. Methods; 117: No. 1, 305-307(1974).

A gamma spectrometer is shown allowing continuous high-field operation of CdTe with MIS contacts. Resolution is 12 keV at 662 keV with 0.15 cm^3 crystals. The dead time is below 1% at −20°C. (auth)

6728 STABLE ADC FOR USE WITH Ge(Li) DETECTORS. Lucas, C. H. (Jet Propulsion Lab., Pasadena, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 798-804 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A new type of ADC is being developed to satisfy the requirements of the HEAO high spectral resolution gamma ray spectrometer. This 13 bit design utilizes a double successive approximation technique that overcomes the usual differential linearity problem. Stability of a few ppm/°C, differential linearity of 2% and integral linearity of 0.05% have been demonstrated. (auth)

6729 COMPARISON OF Ge(Li) AND ANTI-COMPTON SYSTEMS FOR MEASUREMENTS OF ENVIRONMENTAL SAMPLES. Wogman, N. A. (Battelle Pacific Northwest Labs., Richland, WA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 526-535(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

There are numerous reasons for performing environmental measurements for routine health or safety monitoring and to determine the movement of trace elements or radionuclides through our environment to man. This is often a requirement for the licensing of nuclear power reactors, as well as many other meteorological or environmental research experiments. In this paper a variety of sensitive low-level counting systems have been discussed from an analyst's viewpoint, centering on a variety of NaI(Tl) and Ge(Li) gamma ray spectrometers. The coincident gamma-ray emitters are most sensitively detected through NaI(Tl) multi-dimensional gamma ray spectrometry, while single gamma ray emitters are very sensitively detected with Ge(Li) detector systems. NaI(Tl) detector systems are superior in general for environmental measurements. (auth)

6730 GAMMA-RAY SPECTRUM ANALYSIS TECHNIQUE FOR LOW-LEVEL ENVIRONMENTAL RADIONUCLIDES. Wood, R. E.; Palms, J. M. (Emory Univ., Atlanta). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 536-542(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The requirements for gamma-ray spectra analysis for low-level environmental radionuclides are reviewed. Special emphasis is placed on the routine and rapid analysis of large numbers of samples. Pertinent requirements for analysis include the system energy and efficiency calibration, the library of gamma rays of concern, criteria of establishing the limits of sensitivity and techniques used for gamma-ray intensity and background determinations. An analysis code (CETUS) used with a Ge(Li) detector and multichannel analyzer interfaced to a programmable desk-top calculator is described. (auth)

6731 Ge(Li) LOW LEVEL IN-SITU GAMMA-RAY SPECTROMETER APPLICATIONS. Phelps, P. L.; Anspaugh, L. R.; Roth, S. J.; Huckabay, G. W.; Sawyer, D. L. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 543-552(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Currently we are employing a Ge(Li) spectrometer for in-situ measurements of radionuclides contained in soil. This is being done at nuclear reactor sites and in complex radionuclide fields at the Nevada Test Site. The methodology and precision of the in-situ spectrometric technique has previously been established for analysis of radionuclides in soil. Application of the technique to gaseous and liquid effluents containing radionuclides has shown a great deal of promise. (auth)

6732 PERFORMANCE AND COST COMPARISON OF A LARGE Ge(Li) DETECTOR AND SMALLER Ge(Li)–NaI(Tl) COMPTON SUPPRESSION SYSTEM. Sanderson, C. G.; Latner, N. (Atomic Energy Commission, New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 553-557(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The performance characteristics of a high efficiency, high resolution (20%-1.85 keV) Ge(Li) gamma-ray detector have been evaluated and are compared with a lower efficiency (13%) Ge(Li) system having NaI Compton suppression. This comparative evaluation, based on the analysis of low level environmental samples, indicates that the high performance detector generally provides better sensitivity than a comparably-priced Compton suppression unit. (auth)

6733 AIRBORNE SURVEYS OF TERRESTRIAL GAMMA RADIATION IN ENVIRONMENTAL RESEARCH. Burson, Z. G. (EG and G, Inc., Las Vegas, NV). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 558-571(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Aerial surveys of terrestrial gamma radiation have many applications. These include (1) mineral exploration, (2) nuclear facilities environmental monitoring, (3) water equivalent of snow cover determinations, and (4) soil moisture estimates. The latter two applications are not yet operational in the United States, although snow surveys have been conducted in the USSR for many years. The primary detectors for all applications is the NaI(Tl) crystal. Single and multiple arrays are flown in a variety of aircraft (including helicopters) at altitudes varying from 25 to 150 m. Accuracy of results appear adequate for most applications. Accuracies can be improved by better accounting for the background components, particularly airborne radioactivity. (60 references) (auth)

6734 AIRBORNE GAMMA RAY SPECTROMETER AND ITS APPLICATION IN NUCLEAR POWER PLANT SITE SURVEYS. Fryer, G. E. (Rice Univ., Houston, TX); Adams, J. A. S. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 572-584(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Airborne radiometric surveys from low flying helicopters have been completed for three nuclear power plant sites in Texas. The gamma ray counting data acquired in the air are converted to ground dose rate and plotted as a series of profiles. A radial (spokes-of-a-wheel) flight line pattern provides easy position control and concentrates sampling density over the plant site. The 5- to 8-fold range of natural and man-made radiation background within 10 miles of the three plant sites is statistically well characterized by over 14,000 spectra taken directly from 3.8% of each 314 square mile survey area. The aerial dose estimates agree closely with thermoluminescence dosimeter (TLD) data taken on the ground over three month periods. The instrumentation system, survey rationales, data reduction, and analysis procedures are described. (auth)

6735 COMPARISON OF THE IN-SITU MEASUREMENT OF TERRESTRIAL AMERICIUM WITH A Ge(Li) SPECTROMETER AND A FIDLER. Roth, S. J.; Huckabay, G. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 438-443(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The evaluation of the sensitivity of a Ge(Li) coaxial detector in comparison with a thin NaI(Tl) detector in in situ terrestrial ^{241}Am is described. The experiment was performed in areas of natural background and fallout products. Of primary concern is the detec-

tion of ^{241}Am 60 keV gamma ray. Calculated from these data are the corresponding quantitations of ^{239,240}Pu. (auth)

6736 INSTRUMENT TO MEASURE ENERGY AND CHARGE OF LOW ENERGY INTERPLANETARY PARTICLES. Tums, E. (Univ. of Maryland, College Park); Gloeckler, G.; Fan, C. Y.; Cain, J.; Sciambi, R. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 210-217(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

An experiment to measure the charge composition and energy spectra of ultra low energy charged particles in interplanetary space has been developed and launched on the IMP 8 (Explorer 50) satellite on 26 October 1973. The instrument consists of two separate sensors sharing common electronics. One of these sensors, developed by Max Planck Institut, uses a thin window gas proportional counter to measure the rate of energy loss and a totally depleted silicon surface barrier detector to measure total energy of incoming particles. The energy range for two dimensional analysis extends from 300 keV to 2.5 MeV for protons and 60 keV/nucleon to ~25 MeV/nucleon for iron with excellent resolution of individual chemical elements. The other sensor, developed at the University of Maryland, combines electrostatic deflection with total energy measurements in silicon surface barrier detectors to give the ionic charge and kinetic energy of the particle. The overall energy range of the electrostatic analyzer is from ~125 keV to ~1.25 MeV for singly charged ions and from 37 keV/charge to 1.25 MeV/charge for particles with charge ≥4. (auth)

6737 PULSE AREA ANALYZER (PAA) FOR HIGH RESOLUTION GAMMA RAY SPECTROSCOPY. Smeins, L. G.; Juergens, D. W. (Ball Bros. Research Corp., Boulder, CO). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 247-250 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A different type multichannel analyzer has been designed, built, and tested for the High Spectral Resolution Gamma Ray Spectrometer to be flown on the HEAO spacecraft. This system offers superior dynamic range, energy conversion, and stability for large Ge(Li) detectors. Theoretical and measured results from an 8192 channel analyzer are presented. (auth)

6738 SATELLITE-BORNE HIGH RESOLUTION Ge(Li) GAMMA-RAY SPECTROMETER SYSTEM. Part 2. Description of the Electronic, Data Handling, and Auxiliary Sensor Systems. Bakke, J. C.; McDaniel, J. D.; Matthews, J. D.; Reagan, J. B. (Lockheed Missiles and Space Co., Palo Alto, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 164-168(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The first high-resolution gamma-ray spectrometer system employing Ge(Li) detectors has been designed and successfully flown on an earth-orbiting satellite. The complete scientific payload consists of two large-volume Ge(Li) spectrometers for the measurements of photons in the 40 keV to 2.8 MeV energy range with 4096-channel energy resolution and six auxiliary sensors for measuring the location, intensity and energy spectra of charged-particle backgrounds in earth orbit. To achieve and maintain an overall systems resolution of 3.5 to 4 keV in photon energy, a low-noise bias power supply and charge sensitive preamplifier-amplifier combination were designed for the germanium detectors. Amplified signals are analyzed in a 4096-channel analyzer of the linear-ramp type, with an integral and differential linearity of ± 0.2 percent and ± 1.0%, respectively. Individual pulse-height addresses are sampled at a rate of 1625 addresses/sec and time tagged together with absolute count-rate data by the experiment digital-data-handling system and then stored on magnetic tape recorders. A detailed description of the gamma-ray spectrometer electronic system including the method of collecting and analysis of flight data is given. (auth)

6739 LOW-LEVEL COUNTING. Schroeder, A. N. F. (Univ., Cologne). (1972). vp. (In German).

From specialist meeting nuclear technology; Frankfurt am Main, Ger. (22 Feb 1972).

A high-sensitivity gamma spectrometer incorporating a high performance Ge(Li)-detector and a NaI(Tl)-ring crystal was developed. It permits measurements in the 0.1 pCi range to be made. (GE)

6740 RECENT ADVANCES IN γ-RAY SPECTROSCOPY. Ince, A. J.; MacMahon, T. D. (London Univ.). Proc. Soc. Anal. Chem.; 11: No. 5, 129-131(May 1974).

A summary is presented of recent advances in the field of gamma-ray spectroscopy. A table shows the characteristics of some germanium (lithium) detectors currently available. The advantage of using a carefully designed sodium iodide Compton-suppression ring is discussed. Comments are made on advances in the design of pre-amplifiers, amplifiers, analogue-to-digital converters and multichannel analysers. (UK)

6741 SEMICONDUCTOR α-SPECTROMETER FOR ANALYSIS. Solov'ev, S. M.; Smirnov, A. N.; Eismont, V. P. Sov. J. At. Energy (Engl. Transl.); 34: No. 1, 43-44(Jan 1973).

Translated from At. Energy. (USSR); 34: No. 1, 34(Jan 1973).

The fabrication and performance of a Si semiconductor alpha spectrometer for isotopic analysis are described. Representative alpha spectra of ^{239}Pu and a mixture of ^{229}Th and ^{234}Th are given. (WHK)

6742 TEMPERATURE STABILITY AND DEPENDENCE OF THE RESULTING PARAMETERS OF SCINTILLATION DETECTORS WITH NaI(Tl) AND CsI(Na) CRYSTALS AND 66 PK 512 PHOTOMULTIPLIER. Silar, J.; Jursova, L. Jad. Energ.; 20: No. 2, 45-55(1974). (In Czech).

The results of the measurement of the temperature dependence of the pulse frequency of γ scintillation detectors and the effect of this dependence on the resulting parameters of scintillation radiometers and spectrometers are reported and discussed. The measurements were made for detection systems consisting of the 66 PK 512 photomultiplier in association with NaI(Tl) or CsI(Na) scintillators in the temperature range from 20 to 120°C. (tr-auth)

6743 NOISE IN X-RAY SPECTROMETERS. Uylings, J. H. M. (N. V. Philips Gloeilampenfabrieken, Eindhoven, Netherlands). Electron. Appl. Bull.; 32: No. 2, 61-69(Feb 1974).

The effect of certain factors on the energy resolution of semiconductor detector x-ray spectrometers was calculated and expressed in terms of equivalent noise charge (ENC) and in eV. The factors are: the properties of the field-effect transistor (FET) in the first stage of the charge-sensitive preamplifier, such as input capacitance, transconductance, gate leakage current and cross-over frequency (i.e., from 1/f noise to white noise); the magnitude of the parallel resistance, the series resistance and the detector leakage current; and the time constants of the differentiators and integrators in the main amplifier. The various noise contributions are compared and the most important noise source is determined. (auth)

High Energy Physics Instrumentation

6744 (BNL-18835) PATTERN RECOGNITION CODE FOR CURVED TRACKS IN CYLINDRICAL SPARK CHAMBERS. Schreiner, W. N.; Gilbert, D. R.; Trower, W. P.; Schuebelin, P. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 21p. (CONF-740512-8). Dep. NTIS $4.25.

From second AEC scientific computer information exchange meeting; New York, New York, USA (2 May 1974).

A computer code, PITRACK, which associates sparks into tracks from digitizings produced by a system of nine cylindrical wire spark chambers operating in a 10 kG magnetic field is described and evaluated. PITRACK was written in FORTRAN IV and requires 72K octal words of CDC-6600 core storage for execution. Packing and unpacking routines required by the data tape format account for ~20% of this core. Track recognition time principally depends on the initial number of tracks to be recognized, N, as $t \sim 0.4 + 0.04N^2$(seconds per event). PITRACK identifies ~94% of all tracks found by a human scanner while ~1% of the tracks it found were spurious. (auth)

6745 (LAL-RI-72-10) SIMULATION AND RECONSTRUCTION OF ELECTRON TRACKS IN A BUBBLE CHAMBER. Picard, D. (Paris-11 Univ., 91-Orsay (France)). 1973. 99p. (In French). Dep. NTIS (US Sales Only) $8.00.

Thesis.

The Large Bubble Chamber Geometry (LBCG) program was used to verify and develop the electron track measurement technique. Monte Carlo simulated tracks were introduced into the final part of the fitting, i.e., the part which takes physical effects into account. Particular care was taken in simulating the bremsstrahlung. The method gives good results (momenta, angles, error estimation) for about 70% of the tracks, a wide energy domain being considered. Photon emission is detected and the tracks correctly cut. The errors in these tracks are well represented by a Gaussian distribution. No emission can be detected when a track emits very early an energetic photon (about 10% of the cases). The momentum can thus be considerably underestimated, the error not taking this

loss into account. The only solution to the problem is to take the showers accompanying the tracks into consideration. Another 20% of the tracks remain for which the momentum is underestimated by between 5 and 10% without any increase in the error to compensate for this underestimation. Radiation losses were estimated from studies of the weight variations as a function of the losses by the weight parameters. It was verified that this parametrization was correct with the liquid and errors occurring in the $2\pi^0$ experiment. (FR)

6746 (LNF-73-72) DESCRIPTION OF AN APPARATUS FOR THE MEASUREMENT OF THE PHOTOPRODUCTION OF π^0 ON DEUTERIUM. Barotti, M.; Di Capua, E.; Giacalone, R.; Matone, G.; Pocci, V.; Satta, L.; Tau, L.; Ubaldini, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 28 Dec 1973. 19p. (In Italian). Dep. NTIS (US Sales Only) $4.00.

The technical characteristics of an experimental device for the measurement of the photoproduction of π^0 are described. The system consists essentially of a coincidence lead–scintillator γ telescope and plastic scintillation neutron detector system and a memory bank, both controlled by an IBM 1800. The signals from the detectors are digitalized and transferred to the SPAD data acquisition system. The data are partially processed and stored on magnetic tapes. Each of these components are described in detail. (JSR)

6747 HIGH RESOLUTION CRYOGENIC SPARK CHAMBERS. Atac, M.; Taylor, W. E. (National Accelerator Lab., Batavia, IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 65-69(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A cluster of four narrow gap (2.5 mm) spark chambers containing 8 wires per millimeter has been built and operated at low temperatures (as low as 118°K). Results obtained from these chambers indicate that the width of the spark column is reduced at lower temperatures due to the increased gas density. Electron diffusion and deviation of the spark column from the true particle trajectory are greatly reduced at lower temperatures with narrow gap spark chambers. Space resolutions less than σ = 70 microns (HWHM) has been achieved and even better resolutions are predicted from the observed temperature dependence. (auth)

6748 FAST ON-LINE SELECTION SYSTEM FOR PARTICLE TRAJECTORIES DETECTED BY MULTIWIRE PROPORTIONAL CHAMBERS. Aebischer, D.; Bovet, R.; Favier, B.; Greeniaus, G.; Hess, R.; Junod, A.; Lechanoine, C.; Mauron, B.; Nikles, J. C.; Rapin, D.; Vittet, J. P.; Werren, D. W. (Univ., Geneva). Nucl. Instrum. Methods; 117: No. 1, 131-139(1974).

A system of decision-making elements used together with MWPC's in small angle scattering experiments is described. The aim has been to develop a system of general usability under complete computer control, including reliability checks. (auth)

6749 BUBBLE GROWTH AND BUBBLE DENSITIES IN BUBBLE CHAMBERS FILLED WITH NEON/HYDROGEN MIXTURES. Horlitz, G. (DESY, Hamburg); Wolff, S.; Harigel, G. Nucl. Instrum. Methods; 117: No. 1, 115-124(1974).

Operating conditions for pure neon and various mixtures of neon and hydrogen have been investigated in the DESY 85 cm cryogenic bubble chamber. Measurements of bubble densities and growth rates for different temperatures and pressures have been made which complement former results in pure hydrogen and deuterium. (auth)

6750 TWO-DIMENSIONAL READ-OUT OF A WIRE SPARK PLANE. Gustavsson, K.; Hagberg, E.; Kullander, S.; Moberg, H. O. (Uppsala Univ.). Nucl. Instrum. Methods; 117: No. 1, 171-175(1974).

Lumped delay lines have been applied for the read-out of one of the surfaces of a cylindrical wire spark chamber with a circumference of about 1 m. The height of the pulse induced in a coil gives information as to where along an axial wire the spark occurred and the time delay of the pulse gives information about the location of the wire. In this way information about the two coordinates is contained in one and the same signal and for the case of several sparks the reconstruction is simplified. Intrinsic standard errors obtained are $\sigma \approx 0.5$ mm for the azimuthal and $\sigma \approx 1.5$ mm for the axial coordinate. (auth)

6751 VERY LARGE PROPORTIONAL DRIFT CHAMBERS WITH HIGH SPATIAL AND TIME RESOLUTIONS. Cheng, D. C.; Kozanecki, W. A.; Piccioni, R. L.; Rubbia, C.; Sulak, L. R.; Weedon, H. J.; Whittaker, J. (Harvard Univ., Cambridge, MA). Nucl. Instrum. Methods; 117: No. 1, 157-169(1974).

The design, construction and performance of very large (13 m^2) drift chambers are described. Accurate time (11 ns) and position (0.35 mm) determinations are obtained by the use of a redundant number of planes. The general organization of the associated electronic read-out and a particular scheme utilizing a time expander are discussed. (auth)

6752 ENERGY CALORIMETER FOR A COSMIC GAMMA-RAY DETECTOR. Sood, R. K.; Rochester, G. K.; Clayton, P. G. (Imperial Coll. of Science and Tech., London). Nucl. Instrum. Methods; 117: No. 1, 311-313(1974).

A design study for a relatively inexpensive lead-glass Cherenkov calorimeter suitable for the measurement of the energies of electrons and gamma rays in the range 200 MeV to 10 GeV is described. (auth)

6753 A ROBUST, COMPACT, AND VERY FAST RESPONSE MICROCHANNEL WAFER PHOTOMULTIPLIER: HR 300. Boutot, J. P.; Pietri, G. (Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). pp 91-96 of Third Meeting on Spatial Optics. Paris; Centre National d'Etudes Spatiales (1971). (In French)

From third meeting on spatial optics; Marseille, France (21 Sep 1971).

A new type of photomultiplier was developed for high-energy nuclear physics applications from wafer microchannel electromultipliers. An enhanced time resolution is obtained with this new photomultiplier (transit time approximately 1 ns, transit time dispersion $\Delta T < 100$ ps, pulse response < 500 ps), in comparison with more conventional types of instruments. It presents interesting characteristics for space research applications, being compact, robust, and consuming only a small amount of current. These characteristics are obtained by sensitization using the transfer technique, and by employing a structure using metallic anodes and ceramic elements welded together. (FR)

6754 MODULAR MULTI-WORD READOUT SYSTEM FOR PROPORTIONAL WIRE CHAMBERS. Olson, S. R.; Kirsten, F. A.; Binnall, E. P.; Lee, K. L.; Bhandari, N. N.; Nunnally, C. C. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 851-856(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The design features of a data readout system for multi-wire proportional chambers are described. The electronic circuitry for this "amplifier-per-wire" system has been designed in modular form to provide ease in system assembly, flexibility, and economy. Fast readout of the hit-pattern data is accomplished by using priority encoder integrated circuits for address generation and bit-parallel transfer of the output data words. About 7000 channels have been implemented using this system and an additional 4000 channels have been ordered. An analysis of cost per channel is given, based on the experience gained thus far. (auth)

6755 HE 1 MWPC ACQUISITION SYSTEM. Auriol, E.; Cohen, L.; Dupont, J.; Grunberg, C.; Leconte, P.; Le Devehat, J.; Lefebvre, M. (CEN de Saclay, Gif-sur-Yvette, France). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 862-866(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

This system has been designed to fulfill the needs of (e,e') and (e,e'p) experiments at the 600 MeV Linear Accelerator of Saclay. The configuration of the experimental set-up consists in two high resolution spectrometers and associated detectors. Localization of the particle is done for each spectrometer, through a set of two multiwire proportional chambers; one being in the focal surface of the spectrometer. The time definition of the event will be taken from the fast coincidence of two high speed detector arrays. The main characteristic of this system is that it must accommodate the necessary high counting rate. The essential features of this realization are briefly described. (auth)

6756 FAST READOUT AND GEOMETRICAL RECONSTRUCTION SYSTEM FOR PROPORTIONAL WIRE CHAMBERS. Dhawan, S. (Yale Univ., New Haven). Contract AT(11-1)-3075. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 922-924(Feb 1974). (COO-3075-57).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

This system handles data from each proportional wire chamber in parallel, and forms computer words containing wire addresses. These data are transmitted bit serially at 10 MHz to a CAMAC Module containing 16 words of storage. Double event resolution is less than 10 μsec. Arithmetic logic can be performed for geometrical reconstruction of particle tracks. (auth)

6757 PROPORTIONAL WIRE CHAMBER READOUT SYSTEMS AT DARESBURY NUCLEAR PHYSICS LABORATORY. Beech, J. C.; Peatfield, A. C.; White, A. J. (Daresbury Nuclear Physics Lab., Eng.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 919-921(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The development of large readout systems for proportional wire chambers was hindered for some time by the lack of mass-produced hybrid or integrated circuits for the amplifier, shaper, delay, memory and readout elements. However, two large experiments, involving a total of 12,000 wires, have now been equipped with hybrid elements and incorporated in a CAMAC-interfaced readout highway. (auth)

6758 GAS THRESHOLD CHERENKOV COUNTER DESIGNED FOR WIDE BEAMS IN THE ENERGY RANGE OF SEVERAL GeV. Abramyan, L. O.; Adamyan, F. V.; Vartapetyan, G. A.; Khudaverdyan, A. G. (Erevan Physics Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 4, 283-289(1973). (In Russian).

A Freon-13-filled threshold Cherenkov counter designed for a beam of 20 cm in diameter is described. The resolution of the Cherenkov counter is $\Delta\beta/\beta \sim 2 \times 10^{-3}$ and the particle registration efficiency is nearly 100%. (auth)

6759 INVESTIGATION OF XTR DETECTOR ON THE BASIS OF ENERGY DEPOSITION. Kankanyan, S. A.; Kocharyan, M. S.; Oganesyan, A. G.; Tamanyan, A. G. (Erevan Physics Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 4, 305-308(1973). (In Russian).

The results of experimental investigations of the XTR (x-ray transition radiation) detector for 2.5- and 3.6-GeV electrons are given. The registration of the x-ray transition radiation was done in a gaseous xenon scintillation detector. (auth)

6760 NEW TRANSITION RADIATOR-DETECTOR SYSTEMS FOR PARTICLE IDENTIFICATION AT HIGH ENERGIES. Fischer, J. (Brookhaven National Lab., Upton, NY); Iwata, S.; Radeka, V.; Wang, C. L.; Willis, W. J. Phys. Lett.; 49B: No. 4, 393-396 (29 Apr 1974).

Transition radiation (TR) from a new low Z radiator of lithium foils was investigated with a xenon gas multiwire proportional chamber. The TR x-ray yield was determined as a function of the Lorentz factor from $\gamma \approx 1000$ to 5600. The particle discrimination properties of the Li-radiator and Xe-detector combination were found superior to those reported with other TR detectors. (auth)

Radiometric Instruments

Refer also to abstract 6733.

6761 (INIS-mf-887-1, pp 135-145) STABILITY AND INTRINSIC ERROR OF RADIOMETRIC GAGES. Novakova, O. (Tesla, Premysleni, Czech). [nd]. (In Czech).

An instruction is presented for the selection, according to a specific configuration, of measuring conditions when the stability of a radiometric gage is verified. Criteria are listed of the optimum selection of operating conditions in view of the stability of the device, this not only in selecting the parameters of the electronic evaluation section but also in selecting the emitter and possibly the emitter-sensor geometry. (INIS)

6762 (INIS-mf-995) GAMMA RAY INSTRUMENTS FOR THE MEASUREMENT OF THE WATER EQUIVALENT OF A SNOW PACK. Rossi, G. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). Mar 1973. 16p. (In Italian). INIS.

From 18th nuclear congress; Rome, Italy (26 Mar 1973).

The use of gamma radiation for the measurement of the water equivalent of a snow pack is described. Such measurements are of particular importance to optimize the use of the hydraulic resources for electric energy production. The measuring methods and the equipments used are described reporting the accuracy and reliability problems which have been solved. (INIS)

6763 (INIS-mf-998) RECENT APPLICATIONS OF NUCLEAR RADIATIONS TO PORTABLE SYSTEMS FOR ON-LINE CONTROL AND ANALYSIS. Sciuti, S. (Rome Univ. (Italy)). [nd]. 17p. (In Italian). INIS.

From 18th nuclear congress; Rome, Italy (26 Mar 1973).

A general survey on the methods and equipments used in materials analysis by nuclear radiations is presented. On-line and portable systems are particularly examined. A system for neutron radiography is presented with some detail, including the neutronic source (Am-Be) and the electronic circuits. (INIS)

6764 (UCRL-75114) NEUTRON LOGGING IN PARTIALLY SATURATED MEDIA. Hearst, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Apr 1974. 26p. (CONF-740619-1). Dep. NTIS $4.50.

From international seminar on instruments and systems for measuring and monitoring water quality and quantity; Chicago, Illinois, USA (4 Jun 1974).

At the Lawrence Livermore Laboratory we have been studying the behavior of epithermal neutron logging equipment in large holes in partially saturated alluvium and in ashfall and ashflow tuff. Monte Carlo neutron transport calculations indicate that the number of epithermal neutrons from either a fission or 14-MeV source depends not only on the water content of the medium, but also on its bulk density. Curves as functions of both parameters have been developed and an interpolation method devised. A calibration facility to test these calculations is being designed. Attempts to calibrate neutron logs by comparing log-measured water content with water content from cores result in unacceptably large errors. Part of the error is due to the fact that commercial neutron logs are quite sensitive to hole size variations. We show that with proper shielding the hole size effect can be eliminated. An effort is in progress to study the two water contents, bulk density, and material type in a number of holes to determine whether core data calibration would be satisfactory with proper corrections. (auth)

6765 EFFECT OF BULK DENSITY ON CALCULATED NEUTRON LOG RESPONSE. Hearst, J. R. (Univ. of California, Livermore). Nucl. Instrum. Methods; 117: No. 1, 141-151(1974).

An attempt was made to find a method of obtaining water content from neutron logs in unsaturated materials. A set of Monte-Carlo calculations was run for both 14 MeV and fission (^{252}Cf) neutron sources. Density of a medium composed of hydrogen and oxygen was varied between 1 and 3 g/cm^3; "water content", determined by the amount of hydrogen, was varied between 1 and 53% by volume. The best results were obtained from a fission source by plotting separate curves of count rate versus hydrogen content for each density and linearly interpolating. An attempt was made to interpret count rate to measure hydrogen content behind an invaded zone; this appeared somewhat successful for invasion depths of 10 to 15 cm, and then only by selecting neutrons from a 14 MeV source whose energies at a detector were between 0.1 and 3.4 eV. A plausible resolution of an anomalous situation was obtained; material having a density of 1.6 g/cm^3 and a water content of about 13% by volume was shown by a log to have a water content of about 30% by volume. Designs of partially saturated calibration facilities are proposed. (auth)

6766 NUCLEAR INTRACRANIAL PRESSURE SENSOR. Bustard, T. S. (Nuclear Battery Corp., Columbia, MD); Lyon, W. C.; Meyer, G. A. Contract AT(11-1)-3206. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 697-701(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Knowledge of the intracranial pressure would prove medically valuable in the treatment of congenital hydrocephalus and severe head trauma. An indwelling sensor, utilizing a radioactive material as the pressure transmission signal, has been developed. The unit is compact, totally implantable, requires no electrical power, and is self-compensating for external temperature and pressure. Development of the sensor has proceeded through in vitro and primate in vivo testing. Clinical trials are expected in early 1974. (auth)

6767 CHRONIC IN VIVO TESTING OF A FULLY IMPLANTABLE INTRACRANIAL PRESSURE SENSOR. Meyer, G. A. (Medical Coll. of Wisconsin, Milwaukee); Lyon, W. C.; Bustard, T. S. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 702-706(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

This paper describes the authors' approach to the problem of long term intracranial pressure measurement. Several prior devices have not proven useful for clinical studies of more than a few days duration. Study of 22 of the authors' devices in primates has established the validity of both engineering and medical design assumptions. Useful pressure data have been collected for up to 2 months. Redesign to decrease tambour permeability should allow a useful life of months or year. (auth)

6768 METHOD AND APPARATUS FOR RADIOACTIVE WELL LOGGING EMPLOYING PARTIALLY OVERLAPPING TIME WINDOWS FOR DETECTION OF RADIATION. Givens, W. W. (to Mobil Oil Corp.). U. S. Patent 3,800,150. 26 Mar 1974. Filed Date 9 May 1972. 12p.

Methods and apparatus for radioactive well logging in which the formation is irradiated with bursts of primary radiation and the resulting secondary radiation is measured by employing partially overlapping detection windows are described. The invention may be employed in thermal neutron decay logging with the measurements obtained during the partially overlapping time windows employed to derive a decay parameter of the thermal neutron population developed in a formation as a result of bursts of fast neutrons. In addition radiation attendant to the thermal neutron population may be detected over a third time interval and employed to derive a background correction factor, and also to provide an indication of the porosity of the formation. (Official Gazette)

6769 CALIBRATION AND OPERATION OF A SOIL VOLUMETRIC MOISTURE AND WEIGHT METER WHICH USES RADIOACTIVE SOURCES. Renaud, B. C. Mexico City; Universidad Nacional Autonoma de Mexico (1973). 110p. (In Spanish).

Thesis.

The methods commonly used to measure the water content of soil and its volumetric weight are summarized. Meters using neutrons and γ radiation are then described. The physical concepts used in moisture determinations and volumetric weight determinations with neutrons and γ radiation are reviewed, and the experimental devices used in the present study are described. The experimental results show the neutron method of moisture determination has many advantages over conventional methods but in soil densities less than 1 g/cm^3 the results are not satisfactory. The method can be used to study water distribution in soil as a function of time. The γ dispersion method for the determination of the volumetric weight has the same advantages as the neutron method. Improvements need to be made in the calibration methods. (JSR)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

6770 (N-73-17777) DEVELOPMENT OF HIGH-TEMPERATURE, HIGH RADIATION-RESISTANT SILICON SEMICONDUCTORS. Contract Final Report. Whorl, C. A.; Evans, A. W. (Solitron Devices, Inc., Riviera Beach, Fla. (USA). Development Engineering Dept.). 1972. Contract NAS8-25917. 65p. (NASA-CR-124074; DCN-LO-40-2692). NTIS $5.25.

The development of a hardened silicon power transistor for operation in severe nuclear radiation environments at high temperature was studied. Device hardness and diffusion techniques are discussed along with the geometries of hardened power transistor chips. Engineering drawings of 100 amp and 5 amp silicon devices are included. (STAR)

6771 (SLA-73-7053) OPERATION AND RADIATION HARDNESS OF FULLY DECODED 16 × 16 MNOS–REPROM INTEGRATED CIRCUIT. Lodi, R.; Dodson, W. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 11p. (CONF-740612-2). Dep. NTIS $4.00.

From government microcircuit applications conference; Boulder, Colorado, USA (25 Jun 1974).

The operation and performance characteristics of a fully decoded radiation hardened 256-bit MNOS REPROM integrated circuit are described. Experimental data obtained after exposing the circuit to 10^6 rads total dose are presented in conjunction with analysis which predicts the circuit behavior from the characteristics of the individual transistors used with the circuit. (auth)

6772 DEGRADATION OF OPTICAL SYSTEMS IN ENERGETIC SPATIAL ENVIRONMENTS. (Univ., Toulouse). pp 249-264 of Third Meeting on Spatial Optics. Bourrieau, J. Paris; Centre National d'Etudes Spatiales (1971). (In French).

From third meeting on spatial optics; Marseille, France (21 Sep 1971).

A brief review is given of the spatial environment characteristics of atomic particles, electromagnetic radiation, and micrometeorites. The flux penetrating the shielding of space vehicles was also studied. The constraints, which are to be reproduced, are defined and the various simulation methods used are reviewed. Some results of degradations induced in optical materials are indicated. (FR)

6773 NONLINEAR ELECTROMAGNETIC FIELDS WITHIN A CYLINDRICAL CAVITY EXCITED BY IONIZING RADIATION. Merewether, D. E.; Radasky, W. A. (Mission Research Corp., Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 998-1005(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A numerical solution is provided that may be used to predict the electromagnetic field within a partially evacuated cylindrical cavity excited by a pulse of ionizing radiation. Several examples are given to illustrate the pressure dependence of the nonlinear response and to acquaint the reader with principal characteristics of this response. (auth)

6774 CLOSED-FORM EXPRESSION FOR THE ENERGY DISSIPATION IN A LOW-LOSS TRANSMISSION LINE. Yee, K. S. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 1006-1008(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

An uncharged two-conductor transmission line is considered whose ends are terminated in resistances. Initially the line is assumed to be charged along its length for a time interval that is short compared to the transit time along the line, as in the case of a cable irradiated with x rays. It is shown that the distribution of the subsequent energy dissipation in the line and its terminations can be calculated in closed form if the line is assumed to have low losses. The result is of interest in some internal electromagnetic pulse (IEMP) problems. (auth)

6775 IRRADIATION EFFECT OF CURRENT COMPONENTS OF GATE-CONTROLLED BIPOLAR TRANSISTOR. Butsens, G. V.; Matveev, I. G.; Trilisskii, V. A. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 1, 30-35 (1974). (In Russian).

The effects of reactor and fast electron irradiation on the components of the base current in silicon planar gate-controlled transistors were investigated. The surface effects of irradiation were separated from the volume effects. The irradiation effects on the base current components originating in the emitter space charge region are shown. (auth)

6776 EFFECT OF NEUTRON RADIATION ON THE SPECTROMETRIC CHARACTERISTICS OF Si(Li) DETECTORS. Solov'ev, S. M.; Tybin, L. I.; Eismont, V. P. Sov. J. At. Energy (Engl. Transl.); 33: No. 5, 1065-1066(Nov 1972).

Translated from At. Energ. (USSR); 33: No. 5, 918-919(Nov 1972).

The degradation of the energy resolution of Si(Li) gamma and x-ray spectrometers due to neutron irradiation was studied. A ^{252}Cf neutron source was used for the measurements. Results are presented. (WHK)

6777 EFFECTS OF IONIZING RADIATION ON TRANSMISSION OF OPTICAL FIBERS. Sigel, G.H. Jr.; Evans, B.D. (Solid State Division, Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 24: No. 9, 410-412 (1 May 1974).

The spectral character of the optical absorption produced by ionizing radiation in several fibers and fiber materials has been measured. The nature of the damage has been identified in some of the samples and preliminary work has been successful in synthesizing radiation-protected soda lime silicate glasses for fiber applications. (auth)

Miscellaneous Instruments

6778 (ANL-7943) CHARACTERIZATION OF GAS REFERENCE OXYGEN-METER PERFORMANCE IN LIQUID SODIUM SYSTEMS. Vissers, D. R.; McKee, J. M.; Bartholme, L. G.; Nelson, P. A. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-109-eng-38. 28p. Dep. NTIS $4.00.

Twenty commercially available, electrochemical oxygen meters, employing improved $ThO_2-Y_2O_3$ electrolytes and Pt-gas reference electrodes were tested at two sites to obtain a statistically significant measure of meter performance and to evaluate the site-to-site reproducibility of the results. Ten meters were tested by the Advanced Reactors Division (ARD) of Westinghouse Electric Corporation at Waltz Mill, Pa., and ten meters were tested at Argonne National Laboratory (ANL), Argonne, Illinois. The ten meters tested at ANL are principally dealt with. Over a period of four months of operation at 700 or 900°F, curves of the form: Meter emf (V) = K_1-K_2 log (ppM O) were obtained at ANL for oxygen in sodium from 0.5 to 16 ppM. The meters were calibrated by a method in which the oxygen content of vanadium wires, equilibrated in sodium, is related to the oxygen content of the sodium. The value of K_2 was constant for all meters at 0.048 (700°F) and 0.065 (900°F). If the oxygen meters are cali-

brated once each month by the vanadium-wire equilibration method, the oxygen content indicated by an average meter will be accurate to within a factor of 1.6 (2σ) at 700°F and 1.2 (2σ) at 900°F. Brief studies with modified oxygen meters were also carried out. In this work, both tin-tin oxide and 100 ppM oxygen in argon over platinum were used as the reference electrodes. (auth)

6779 (IFA-NE-16-1974) DATA ACQUISITION SYSTEM FROM UNCORRELATED EXPERIMENTAL INPUTS. Bals, I.; Caprini, M.; Goran, B.; Lutescu, S.; Niculescu, D. (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

A small data acquisition system for neutron physics experiments is described. The system can collect data from 16 uncorrelated experimental inputs and store them in a 4 K memory. (WHK)

6780 (LBL-1(Vol.1)(Add.2)) INSTRUMENTATION FOR ENVIRONMENTAL MONITORING: AIR. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. 1047p.

A comprehensive survey of instrumentation for environmental monitoring is being carried out by the Lawrence Berkeley Laboratory under a grant from the National Science Foundation. Instruments being investigated are those useful for measurements of Air Quality, Water Quality, Radiation, and Biomedical Parameters related to environmental research and monitoring. Consideration is given to instruments and techniques presently in use and to those developed for other purposes but having possible applications to this work. The results of the survey are given as (a) descriptions of the physical and operating characteristics of available instruments, (b) critical comparisons among instrumentation methods, and (c) recommendations of promising methodology and development of new instrumentation. The survey material is compiled in loose-leaf volumes which are periodically updated. Presented here is an update for vol. 1 on Air. An Introduction for air monitoring instrumentation and sections on sulfur dioxide, nitrogen oxides, photochemical oxidants, carbon monoxide, and hydrocarbons are included. (WHK)

6781 (NP-19982) IMMERSIBLE FLUORESCENCE PROBE. Hinckfuss, D. A. (Zinc Corp. Ltd., Broken Hill (Australia)). 10 Mar 1972. 13p. Dep. NTIS (U. S. Sales Only) $4.00.

An x-ray fluorescence analyzer for continuous analysis of flowing or stationary liquids is described. A NaI scintillation detector is used with a radioisotopic x-ray source. (WHK)

6782 (RDT-C-4-5-T(4-74)) PERMANENT MAGNET FLOWMETER FOR LIQUID-METAL PIPING SYSTEMS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Apr 1974. 28p. RSO.

The standard presents requirements for the design, fabrication, testing, and inspection of a permanent magnet flowmeter for measurement of liquid-metal flowrate in piping systems. (TFD)

6783 MEASURING SYSTEM FOR STUDYING THE TIME-RESOLUTION CAPABILITIES OF FAST PHOTOMULTIPLIERS. Lo, C. C.; Leskovar, B. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 93-105(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A measuring system has been developed for studying and optimizing the time-resolution capabilities of fast photoelectric devices, such as standard and microchannel type photomultipliers. The system incorporates a subnanosecond light-pulse generator capable of operating at repetition frequencies up to 3 MHz with output light pulses having a full width at half-maximum of less than 200 psec, and a zero-crossing discriminator which has a time walk of ±40 psec over a 170 mV to 8 V input-pulse amplitude variation. Averaging the data from several successive measurements, the measuring system time resolution is 20 psec. (auth)

6784 REDUCING GAIN SHIFTS IN PHOTOMULTIPLIER TUBES. Cohn, C. E. (Argonne National Lab., IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 146-150 (Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Gain shifts in photomultipliers from count-rate changes can be minimized by using only five active stages, making up the gain with a low-noise preamplifier. Further reductions sometimes result from a dim light shining on the dynode structure. Reductions to less than 1 part in 600 were seen. (auth)

6785 TRANSMISSION AND REFLECTION PROPERTIES OF A CURVED COPPER TUBE USED AS A GUIDE PIPE FOR COLD NEUTRONS. Hofmeyr, C.; Isebeck, K. (Atomic Energy Board, Pelindaba, South Africa). Nucl. Instrum. Methods; 117: No. 1, 9-16(1974).

It was found feasible to use a copper microwave guide as a curved guide pipe for cold neutrons with wavelengths between 3 and 15 Å despite neutron-optical imperfections. This provides the basis for a simple, flexible and inexpensive design of a small-angle-scattering (SAS) facility at a reactor. In order to optimize the SAS system design the transmission characteristics of the microwave guide, which differ considerably from theoretical expectations, were determined in some detail. The reflectivity peaks at 7 Å. (auth)

6786 THIRD MEETING ON SPATIAL OPTICS, MARSEILLE, FRANCE, SEPTEMBER 21, 1971. Paris; Centre National d'Etudes Spatiales (1971). 480p. (In French).

Separate abstracts have been prepared for three of the papers presented. The remaining thirty-two papers were not within the subject scope of NSA. (TFD)

For abstracts of individual papers see: 6753 and 6772.

6787 APOLLO X-RAY FLUORESCENCE SPECTROMETER. Jagoda, N.; Kubierschky, K.; Frank, R.; Bjorkholm, P.; Gray, P. (American Science and Engineering, Cambridge, MA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 194-200(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Located in the Science Instrument Module of Apollo 15 and 16, the x-ray fluorescence spectrometer measured the x-ray fluorescence induced in the lunar surface by the incident solar flux. The fluorescing radiation energy spectra is characteristic of the elemental composition of the lunar surface allowing qualitative and quantitative assessments of the lunar surface. A description of the detectors, circuit functions, on-board data processing techniques, in-flight calibration, hardware, and flight results of the spectrometer is given. (auth)

6788 ENERGY-DISPERSIVE X-RAY SPECTROMETRY FOR MULTIELEMENT POLLUTION ANALYSIS. Rhodes, J. R. (Columbia Scientific Industries, Austin, TX). Contract AT(40-1)-4205. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 608-617(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The elementary principles of energy dispersive X-ray fluorescence spectrometry are outlined with special reference to multielement analysis of pollutants. Typical equipment, using radioisotope sources for X-ray excitation, is described and some results are given for analysis of air particulates, wear debris in oils and suspended and dissolved solids in fresh water. The use of "thin" specimens is discussed for reducing interelement and particle size effects, increasing sensitivity and simplifying preparation of standards and samples. (auth)

6789 BIOMEDICAL APPLICATIONS AND INSTRUMENTAL IMPLICATIONS OF ION MICROPROBE. Cho, Z. H.; Singh, M.; Mohabbatizadeh, A. (Univ. of California, Los Angeles). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 622-627(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

An effort has been made to construct a heavy-ion scanning microprobe. Some preliminary results on beam-optics are presented, and a new technique for measuring the beam spot size is reported here. The performance of ion beams as a source for characteristic x-ray production has been studied. As a justification of this work, a brief comparison is made between the x-ray excitation probabilities of protons and heavy ions on the one hand, and that of electrons and x-rays on the other. The present work is a first step toward the future construction of a high resolution ion microprobe which would have a beam size smaller than 1 μm. (auth)

6790 PROGRAMMABLE AND AUTOMATED SYSTEM FOR GAMMA AND X-RAY ANALYSIS. McAdams, V. D.; Atkinson, S. D.; Gage, S. J. (Babcock and Wilcox Co., Lynchburg, VA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 605-607(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A programmable, automatic system was developed to analyze multiple samples by either neutron activation analysis or non-dispersive X-ray analysis. The system incorporates a Nuclear Data Series 2200 multichannel analyzer and a NOVA 800 minicomputer. An analyzer-computer interface, a sample changer, and computer software were designed and developed. The completed system was tested to illustrate its usefulness. (auth)

6791 SCANNING ELECTRON MICROSCOPE AS AN ANALYTICAL TOOL. Pease, D. E.; Dao, J. (Etec Corp., Hayward, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 788-793(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A brief review of recent advances in the quantitative capabilities of the scanning electron microscope is presented. Special emphasis is placed on scanning transmission electron microscopy, X-ray techniques, secondary ion mass analysis, selected area electron channeling patterns, and image processing techniques. A systems approach to the development of the SEM as a research tool is recommended. (auth)

6792 CAMAC SCANNING DVM SYSTEM. Brenner, A. E.; Martin, R. G. (National Accelerator Lab., Batavia, IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 931-933(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A CAMAC interface and control module has been developed at NAL for the Hewlett-Packard 3485A scanning DVM. This system is used to scan a number (≤50) of analog channels, digitize them and store the signed digitized value, channel number, scale factor and overflow indicator into a solid state buffer memory. An optional multiplexer unit may be added to the basic scanning system to expand the number of analog channels, which may be scanned, to four hundred. (auth)

6793 DIGITIZING AND DISPLAY OF SUBNANOSECOND SINGLE TRANSIENTS VIA SCAN CONVERSION. Cavoretto, J. L. (Tektronix, Inc., Beaverton, OR); Infante, C. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 812-816(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The analysis of fast single transients has long been one of the most challenging problems in oscillography. The instrument described uses a scan converter tube with separate write and read electron guns and a silicon diode array target. The charge gain properties of the target are put to good use in achieving the ability to display, or to digitize in a 512 × 512 matrix, single transients one nanosecond or less in duration. (auth)

6794 CAMAC AS A COMPUTER PERIPHERAL INTERFACE SYSTEM. Peatfield, A. C.; Spurling, K.; Zacharov, B. (Daresbury Nuclear Physics Lab., Eng.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 867-869(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

CAMAC is used extensively in the laboratory for data acquisition purposes in conjunction with small computers. The use of CAMAC has been further extended into the area of peripheral interfacing, with the advantages both in convenience and cost. This development has made possible, for the first time, standardization of peripherals and interfaces while allowing advantage to be taken of new mini-computer developments. (auth)

6795 HIGHWAYS FOR CAMAC SYSTEMS: A BRIEF INTRODUCTION. Costrell, L. (National Bureau of Standards, Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 870-875(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The interconnection between CAMAC crates and between the crates and a computer is called the CAMAC highway. A brief summary of CAMAC highway configurations is presented to put in perspective the highway papers that follow and to serve as a starting point for the panel discussion on CAMAC highways. (auth)

6796 CAMAC SERIAL SYSTEMS DESCRIPTION FOR LONG LINE, MULTICRATE APPLICATIONS. Machen, D. R. (Los Alamos Scientific Lab., NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 876-880(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The current status of the Description and the proposed Specification on "CAMAC SERIAL SYSTEM ORGANIZATION" are reviewed. The concept of a Serial Highway and the use of Serial Crate Controllers for long line, multicrate applications are compared to the existing Branch Highway and Crate Controllers for parallel, multicrate applications. (auth)

6797 CAMAC FOR DATA LINKS AND COMPUTER COMMUNICATIONS. Zacharov, B. (Daresbury Nuclear Physics Lab., Eng.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 898-902(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The role of CAMAC in the implementation of data links, terminal interfaces and communications sub-systems is discussed with particular reference to the work at Daresbury. The advantages of using CAMAC in these applications is emphasized, together with its importance in the realization of integrated computer networks. (auth)

6798 INTRODUCTION TO THE CAMAC INTERMEDIATE LANGUAGE. Hooton, I. N. (Atomic Energy Research Establishment, Harwell, Eng.); Hagan, P. J. IEEE (Inst. Elec. Electron. Eng.); Trans. Nucl. Sci.; NS-21: No. 1, 903-908(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A low level language, currently called IML, is being defined by the ESONE and NIM-CAMAC Software Working Groups. It is intended for use in diverse system environments. An informal description of the language, including examples, is given. (auth)

6799 CAMAC STAND-ALONE CONTROL SYSTEM (CAMSAC). Martin, R. G. (National Accelerator Lab., Batavia, IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 909-911(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A multi-task programmable stand alone control system (CAMSAC) has been developed at NAL for the purpose of testing or controlling CAMAC modules/systems. Functionally the CAMSAC module acts as a branch driver and communicates with CAMAC crates via the Type A-1 crate controller, thus numerous crates may be used with this control scheme. (auth)

6800 CAMAC SERIAL SYSTEM WITH PROGRAMMABLE CRATE CONTROLLER. Halling, H. (Kernforschungsanlage, Juelich, Ger.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 886-888(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Implementation of the CAMAC serial highway using programmable crate controllers (SCC) provides some autonomy for each crate. A microcomputer chip is the heart of the SCC. ROM memory holds programs for controlling serial highway with local microprocessor programs written in IML for controlling CAMAC. (auth)

6801 INTEGRATED CIRCUIT ANALYZER-COUNTER-RATEMETER AND POSITION DEVICE FOR NUCLEAR SPECTROSCOPY STUDIES. Thiess, P. E.; Visel, T. A.; Kwitkowski, P. A. (Univ. of Illinois, Urbana). Contract AT(11-1)-2007. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 826-837(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

An inexpensive, integrated circuit single channel analyzer, counter and ratemeter with a logic unit to drive a stepping motor for positioning a device such as a grating of a monochrometer or varying an applied voltage is described. In addition to the analyzer and counter, the circuitry includes a time base for control functions, circuits for synchronous counting to subtract photomultiplier or detector "dark" noise, a serial integrator for weak signals and a rate meter for larger signals, and the stepping motor logic. The system has been applied to studies of optical spectra produced in a gas proportional scintillation counter, where single photon counting was utilized with a ¾ meter monochrometer. (auth)

6802 FUNCTIONAL DISTRIBUTION: AN ARCHITECTURE FOR MULTI-USER COMPUTER NETWORKS IN INSTRUMENTATION. Dimmler, D. G. (Brookhaven National Lab., Upton, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 838-850(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A new approach is introduced for the design of Multi-User Real-Time Computer Networks. The approach leads to a system architecture called "Functional Distribution". Definitions of the concept and key issues of a practical implementation are discussed using as an example a Multi-User Experiment Control System. The discussion also includes the architecture of that hardware which has been traditionally referred to as the "interface between an experiment and a computer" (auth)

6803 QUANTUM UTILIZATION IN X-RAY INTENSIFYING SCREENS. Sklensky, A. F.; Buchanan, R. A.; Maple, T. G.; Bailey, H. N. (Lockheed Missiles and Space Co., Palo Alto, CA).

IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 685-691 (Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A comprehensive comparison of the different rare-earth oxysulfide x-ray screens is given. Relative speed and resolution of Y_2O_2S:Tb, La_2O_2S:Tb and Gd_2O_2S:Tb as used with conventional x-ray film and experimental (green sensitive) x-ray film are reported. A comparison is also made of the performance of the experimental rare-earth oxysulfide screens and commercial $CaWO_4$ screens. Both La_2O_2S:Tb and Gd_2O_2S:Tb are observed to be considerably faster than Y_2O_2S:Tb and $CaWO_4$ for screens of comparable resolution. La_2O_2S:Tb perform better for tube voltage below 90 kVp. Above 90 kVp, Gd_2O_2S:Tb is best. These performance characteristics are related to the quantum utilization of the screens. The quantum utilization is defined as the fraction of the x-ray energy incident upon the screen that is actually absorbed by the screen. Calculations of the quantum utilization for oxysulfide and $CaWO_4$ screens are presented. (auth)

6804 METAL-PHOSPHOR INTENSIFYING SCREENS FOR HIGH ENERGY IMAGING APPLICATIONS. Buchanan, R. A.; Sklensky, A. F.; Maple, T. G.; Bailey, H. N. (Lockheed Missiles and Space Co., Palo Alto, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 692-694 (Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

For energy in the range 1 to 25 MeV, phosphor screens alone provide an image of unsatisfactory diagnostic quality. The combination of a metal and phosphor intensifying screen provides improved image quality. The dependence of the light output of such a screen system upon choice of metal, metal thickness, choice of phosphor, and phosphor thickness is presented. Certain metal and phosphor combinations are shown to have sufficient light output for viewing with a low-light-level TV camera. (auth)

6805 TRANSMISSION SCANNING. II. Albert, J. L.; Kraner, H. W.; Bradley-Moore, P.; Atkins, H. L. (Brookhaven National Lab., Upton, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 635-644 (Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Work has been continued on the development of techniques for imaging spatial elemental distributions by means of differential absorption about the K-absorption edge of the particular element Z. A method to correct for spurious effects due to differential absorption in overlying absorber is described. Initial clinical studies of thyroid iodine images on patients are presented. Application of absorption edge transmission scanning to thin in-vitro samples of bone is also discussed. (auth)

6806 ABSORPTION EDGE FLUOROSCOPY. Mistretta, C. A.; Kelcz, F.; Ort, M. G.; Siedband, M. P.; Cameron, J. R.; Crummy, A. B.; Polcyn, R. E. (Univ. of Wisconsin, Madison). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 645-651 (Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The technique presented is an approach to absorption edge transmission imaging which eliminates the need for monoenergetic x-ray sources, detector scanning, and energy analysis of transmitted x-rays. Subtraction of images formed with heavily filtered x-ray beams peaked at energies above and below the K absorption edge is accomplished with image-intensified fluoroscopy equipment coupled to a pair of storage tubes. Images of iodine and xenon concentrations of 1 mg/cm^2 have been imaged in 15 cm phantoms in a few seconds. When automated, the system will provide similar sensitivity in 20 cm phantoms, with imaging times of 1 second or less with resolution on the order of 1 mm. Several preliminary images are presented which relate to possible future clinical studies. (auth)

6807 APPLICATION OF GERMANIUM-LITHIUM SPECTROMETERS IN NEUTRON ACTIVATION ANALYSIS OF ROCKS. Kadisov, E. M.; Miller, V. V.; Shimilevich, Yu. S. (All-Union Scientific-Research Inst. for Nuclear Geophysics and Geochemistry, Moscow). pp 21-42 of Nuclear Geophysical and Geoacoustical Logging of Cased Boreholes in Additional Exploration of Oil and Natural-Gas Deposits. Moscow; Vsesoyuznii Nauchno-Issledovatel'skii Inst. Yaderno Goefizikii i Geokhimii (1973). (In Russian).

The possibility of determining elements in ores in situ using a Ge(Li) spectrometer and a Po-Be neutron source was examined. The results are presented of gamma spectrum measurements on model strata (sand- and carbonate-water saturated and petroleum saturated layers and gypsum layers) under conditions approximately the same as in actual boreholes. With this spectrometer it was possible to determine, in cased boreholes, the chief rock-forming elements with a precision of tenths of a percent. (tr-auth)

6808 ENERGY ANALYZER OF COAXIAL CYLINDRICAL TYPE. Yanagisawa, A.; Fukuhara, A.; Katsuhisa, U. (to Hitachi, Ltd.). US Patent 3,805,057. 16 Apr 1974. Filed date 22 Mar 1972. 12p.

A coaxial cylindrical type energy analyzer includes an input slit for admitting charged particles into an energy analyzing field, and a detecting slit for introducing into a detector charged particles which have passed through the analyzing field. The slits are coaxially disposed opposite to each other across. (Official Gazette)

6809 STATIC MODE MASS SPECTROMETER FOR THE MEASUREMENT OF NOBLE GASES. Merrill, G. L. Jr. (Rensselaer Polytechnic Inst., Troy, NY). J. Mass Spectrom. Ion Phys.; 13: No. 3, 281-290 (Mar 1974).

A "static" mode mass spectrometer has been developed for measuring the fission product gases Xe and Kr in the determination of nuclear fuel burnup. Accurate and reproducible results from samples of less than 10^{10} atoms have been demonstrated. The all metal spectrometer system was designed to operate without dynamic pumping during an analysis so that the noble gas present is not depleted. System pressure from all sources during a run may vary from 10^{-10} torr to 10^{-6} torr. Quantitative gas samples were obtained from low level burnup of 93% enriched ^{235}U, irradiated in a known neutron flux. This method appears feasible for samples as small as 10^7 atoms or even less with the experimental modifications suggested in the text. (auth)

6810 MONOCHROMATIZATION OF NEUTRONS IN MULTIPLE BRAGG SCATTERING. Loshmanov, A.A.; Sigaev, V.N.; Yamzin, I.I. (Institute of Crystallography, Academy of Sciences of the USSR). Sov. Phys.-Crystallogr. 18: No. 4, 530-530 (Jan 1974).

A mosaic zinc crystal was used to monochromatize a neutron beam. The wavelength distribution obtained was analyzed with a diamond powder neutron diffraction pattern and constraints for the use of mosaic monochromators were determined.(AIP)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

6811 (JINR-E6-7780) METHOD OF ELECTROMAGNETIC SEPARATION OF RADIOACTIVE ISOTOPES OF RARE-EARTH ELEMENTS DIRECTLY FROM TARGETS. Latuszynski, A.; Zuber, K.; Zuber, J.; Potempa, A.; Zuk, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

A method of fast extraction of isobars of rare-earth elements by direct separation from the proton irradiated targets without chemical processing is described. Efficiency of the diffusion process for separation of rare earth elements from tantalum targets depending on the temperature and duration of the process has been measured. The conditions for securing a high degree of diffusion during the two to three minute period have been found and the possibility of utilizing the diffusion process for the electromagnetic separation of rare earth elements according to isobars has been proved. Efficiency of the process of separation using the ion sources with the surface ionization has been measured under different conditions. Using the method proposed for investigations in the field of nuclear spectroscopy the gamma-spectra of short-living isotopes with $T_{\frac{1}{2}} \geq 1$ minute have been measured. The new isotopes ^{161}Yb(4.2 min), ^{149}Dy(3.5 min) and ^{133}Pr(1.6 min) have been identified. The possibility of effective application of this method to spectroscopic investigations of many elements has been proved. (auth)

6812 NEW NEA/IAEA REPORT: "URANIUM RESOURCES AND PRODUCTION IN QUESTION". Atoomenergie Haar Toepass.; 16: No. 1, 14-16(Jan 1974). (In Dutch).

A joint report of the Nuclear Energy Agency and the International Atomic Energy Agency is summarized, which extrapolates uranium demand and supply curves to 1990, both for the world as a whole and for individual countries. The general conclusion is that although proved reserves should be adequate to meet anticipated demands in principle, mining and production activities (including enrichment) will need to be stepped up considerably to avoid serious shortfall in the 1980s. (NL)

Isotopic Power Sources

6813 (MDC G-4436) MATERIALS BEHAVIOR IN A PLUTONIA-238/IRIDIUM/GRAPHITE RADIOISOTOPE HEAT SOURCE MOCKUP TEST CONFIGURATION. Watrous, J. D.; Golding, T. A.; Ferguson, W. E. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). Mar 1974. Contract AT(45-1)-2138. 75p. Dep. NTIS $5.45.

As a technology effort in support of the Multi-Hundred Watt (MHW) Radioisotope Thermoelectric Generator (RTG) program, a systems oriented test configuration was designed and utilized to determine materials behavior and interactions, helium vent behavior and iridium mechanical properties. The configuration incorporated a steep thermal gradient, and mocked up materials combinations, and their relative volumes. Microsize (0.75 in. length) and sub-size (1.5 in. length) tensile specimens were utilized. Exposure times were 1250 and 8000 h at temperatures of 1440 to 1100°C. Selected specimens received a post-exposure thermal pulse to 1950°C to simulate postulated orbital reentry conditions. Results indicated that the plutonia fuel form maintained dimensional and structural integrity and did not react directly with the iridium containers. Plutonia did transport to cooler iridium surfaces. Oxygen from the plutonia reacted with external graphite to produce CO and CO_2 gases but in insufficient quantities to be detrimental to the system. At least two mechanisms, iridium transport and impurity oxide movement, contributed to vent plugging which increased with time. Tensile strength and elongation of iridium was unaffected by these thermal exposures when in contact with plutonia or graphite as tested at 1400°C at strain rates averaging 19,000 to 26,000 min^{-1}. (auth)

6814 RADIOISOTOPE POWERED CARDIAC PACEMAKERS. Huffman, F. N. (Thermo Electron Research and Development Center, Waltham, MA); Migliore, J. J.; Robinson, W. J.; Norman, J. C. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 707-713(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Over 50,000 implantable cardiac pacemakers are in use to rehabilitate patients with heart block. The chemical batteries powering these pacemakers usually fail within a few years. A variety of nuclear batteries, with the potential of providing long-lived (10 to 20 years) pacemaker power, are under development. The status of this development is reviewed. Nuclear-powered pacemakers have reached the stage of clinical evaluation. Their cost, although initially high, is not prohibitive. The primary problem inhibiting wide-spread application is the maintenance of fuel capsule integrity under all creditable conditions. (auth)

Radiation Sources

Refer also to abstract 6935.

6815 (LA-UR-74-599) INTENSE NEUTRON SOURCE FACILITY USING A SUPERSONIC JET TARGET. Cline, M. C.; Emigh, C. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 11p. Dep. NTIS $4.00.

Investigations are underway to determine the concept feasibility and design criteria for an intense-neutron-source facility using a supersonic-jet target. This target consists of an expansion nozzle where deuterium gas is accelerated to supersonic velocities and an interaction region where a tritium-ion beam interacts with the supersonic jet of deuterium producing the neutrons. The present research is concerned with the experimental and theoretical design of the expansion nozzle and interaction region. Results of an initial experimental test without ion-beam heating are discussed. The numerical solutions for the initial-experiment configuration as well as three additional solutions are also presented. (auth)

6816 (ORNL-TM-4561) PLUTONIUM–BERYLLIUM SOURCE SAFETY TESTING PROGRAM. Niemeyer, R. G.; Bradley, N. C. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 50p. Dep. NTIS $5.45.

Some representative commercially fabricated Pu-Be neutron sources which had been in service for periods greater than ten years were examined. Three of the five Pu-Be sources which were both destructively and nondestructively tested had weld zone deficiences such as leaks, weld inclusions, excessive roll-over and grain growth, and marginal weld penetration. Due to these deficiencies the tantalum inner capsule cannot be considered a reliable sealed source container. This deficiency does not necessarily reduce the containment reliability of the sources because the outer stainless steel capsule is the primary containment capsule. A recommendation is made to leak test all sources and recall those that leak for reencapsulation or disposal. An improved quality assurance program is recommended for future sources. (auth)

6817 SCATTER-AIR RATIOS FOR TELECOBALT. Hsbic, M.; Kmet, A.; Smolej, V. (Inst. of Oncology, Ljubljana, Yugoslavia). Phys. Med. Biol.; 19: No. 2, 226-228(Mar 1974).

Scatter-air ratios as a function of radius are presented in tabular form for ^{60}Co for ratios up to 50 cm and depths from 0.5 to 30 cm. Calculations were made using the Cunningham method of extrapolation for determining scatter-air ratios for large radii (Phys. Med. Biol.; 17: 42(1972)). The results are compared with those calculated using the relationship $S(d,r) = a(r)\,[d + b(r)/d^2 + c(r)]$, where S is the scatter-air ratio, d is the depth in cm, r is the radius in cm and a(r), b(r) and c(r) are coefficients dependent on the radius. (UK)

Design and Fabrication

Refer also to abstract 6186.

6818 REDUCTION OF $^{54+55}$Fe(III) IN ELECTROLYTIC PRODUCTION OF SOURCES OF SOFT X RADIATION. Danilin, L. D.; Pavlova-Verevkina, A. I. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 466-468(1973).

Translated from Radiokhimiya; 15: No. 3, 460-462(1973).

It was shown that metallic magnesium and hydroxylamine salts may be used for the reduction of $^{54+55}$Fe(III) in the electrochemical preparation of iron-55 sources and recommendations are given for carrying out the reduction process. (auth)

6819 LASER-GENERATED PLASMAS AS A SOURCE OF X RAYS FOR MEDICAL APPLICATIONS. Mallozzi, P.J.; Epstein,

H.M.; Jung, R.G.; Applebaum, D.C.; Fairand, B.P.; Gallagher, W.J. (Battelle's Columbus Laboratories, Columbus, Ohio 43201); Uecker, R.L.; Muckerheide, M.C. J. Appl. Phys. 45: No. 4, 1891-1895 (Apr 1974).

High-resolution medical radiographs have been produced with a laser-generated plasma x-ray source. The nanosecond pulse width is capable of arresting biological motion. In addition, the soft x rays from this source have been transmitted through a new type of x-ray beam handling device, the x-ray pipe, which is an x-ray analogue of the conventional light pipe. This may allow new medical applications such as channeling soft x rays to internal locations of the body without damaging intervening tissue. (auth)

Industrial Uses

Refer also to abstracts 6865, 6872, 6890, and 6895.

6820 (DP-MS-74-27) POTENTIAL MARKETS FOR DEVICES USING ^{252}Cf. Permar, P. H. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. 18p. (CONF-740447-1). Dep. NTIS $4.00.

From californium-252 utilization meeting and workshops; San Diego, California, USA (22 Apr 1974).

The outlook for applications of ^{252}Cf is increasingly optimistic. Substantial business opportunities for systems manufacturers and encapsulators of ^{252}Cf are expected in the coming years. The business value of ^{252}Cf devices should increase from $2.3 million in 1974 to $13 million in 1980. The cumulative 1974 to 1980 U. S. totals involve the sale of more than 1000 devices for a total of $49 million. The foreign market may equal or exceed these figures. Twenty-five end-uses in eight market segments are now recognized. On-stream process control and nuclear materials assay are the largest market segments, and are expected to command more than half of the cumulative 1974 to 1980 market for ^{252}Cf devices. (auth)

6821 (ORO-4333-1) LITERATURE REVIEW AND COMMERCIAL SOURCE EVALUATION OF AMERICIUM-241. Final Report, March 1, 1972 - May 31, 1973. LeVert, F. E.; Helminski, E. L. (Tuskegee Inst., Ala. (USA). School of Engineering). 1 Jun 1973. Contract AT(40-1)-4333. 422p. Dep. NTIS $10.60.

An exhaustive literature survey of the fabrication and applications of ^{241}Am is presented. Commercial ^{241}Am photon and Am/Be neutron sources were obtained and a limited evaluation program was carried out in conjunction with the study. A survey of ^{241}Am fabricators and facilities employing the isotope in instrumentation, was performed and is reported. (auth)

6822 INTRAVASAL KINETICS OF INDIUM-113 π-TRANSFERRIN AND ITS APPLICATION FOR BLOOD VOLUME DETERMINATION. Lange, S.; Das, B. K.; Houbold, U.; Schwartzkopf, W. (Freie Univ., Berlin). Anaesthesist; 22: No. 9, 400-403 (Sep 1973). (In German).

The intravascular kinetics of a new radiopharmaceutical, e.g., an in vitro-generated compound of transferrin and ^{113m}In, was examined in 29 patients. The time pattern of the radioactivity was recorded by taking venous blood samples at short intervals of 2 to 4 h. The initial loss of radioactivity resembles that of conventional indicators of plasma volume; subsequently, the plasma level falls exponentially with a half-time of 14 h. The results of blood volume estimations, using different indicators simultaneously ^{113m}In-transferrin, ^{51}Cr-erythrocytes, and Evans blue), showed a good correlation ($\gamma = 0.94$ and $\gamma = 0.92$). The distribution space of ^{113m}In-transferrin is slightly larger ($x = +6.3\%$) than that of ^{51}Cr-erythrocytes, and it is slightly smaller ($x = -9\%$) than that of Evans blue. The rapid and repeated applicability of ^{113m}In-transferrin will prove to be useful in clinical practice. (GE)

6823 DETERMINATION OF BLAST VELOCITY IN A CUPOLE FURNACE BY THE RADIOISOTOPIC METHOD. Rona, V. (Magyar Tudomanyos Akademia, Budapest). Izotoptechnika; 17: No. 2, 93-104 (Feb 1974). (In Hungarian).

After having been diluted, ^{133}Xe gas was injected in the blast furnace and counting was carried out in a bypass. The maximum error of the data was 2.9% rel. (auth)

6824 INVESTIGATIONS ON THE SETTLING PROPERTIES OF SUSPENSIONS BY GAMMA ABSORPTION. Toth, L. (Femipari Kutato Intezet, Budapest). Izotoptechnika; 17: No. 2, 70-79 (Feb 1974). (In Hungarian).

In bauxite processing the aluminate leach is separated from the red slurry by settling. Conditions cannot be followed theoretically. With the help of a facility developed by the Research Institute for Metals Industry a comparison of settling of red slurry samples was made in order to evaluate the possibility of modelling plant conditions by static laboratory experiments. (auth)

6825 AMERICAN NATIONAL STANDARD GUIDELINES FOR MAINTAINING COBALT-60 AND CESIUM-137 TELETHERAPY EQUIPMENT. New York; American National Standards Institute, Inc. (1974). 12p. (ANSI-N-449-1974).

This standard establishes guidelines for inspection and maintenance of the mechanical, electrical, and radiation-defining components of cobalt-60 and cesium-137 teletherapy equipment. The objective of the standard is to define an effective inspection and maintenance program for teletherapy equipment which will lead to radiation safety of operating personnel and delivery of accurate dose to patients. The standard specifically recommends initial acceptance tests and a schedule of periodic inspection and maintenance operations. The schedule of twenty-one periodic inspection and maintenance operations includes, for example, head movement, electrical and mechanical source-condition indicator check, timer, source-surface distance (SSD), beam orientation, isocenter, facility door interlock, and source leakage. Further specific guidance is given on the maintenance of teletherapy units with rotating shutters, moving source drawer, moving shutter blocks, mercury shutter mechanism, and pneumatic activating systems. The Appendix (which is not a part of the standard) provides information on the effects of radiation on lubricants used in teletherapy units. (auth)

6826 CONTINUOUS VULCANIZATION OF RUBBER PRODUCTS. II. Lueers, W. Gummi, Asbest, Kunstst.; 26: No. 9, 732-740 (1973). (In German).

Vulcanization plants using gamma and electron radiation, isotopic radiation sources and infrared radiation are described. (GE)

6827 RELIABILITY OF RADIOCHEMICAL PLANTS WITH γ-RADIATION SOURCES. Kozlov, Yu. D.; Filaretova, L. G. Sov. J. At. Energy (Engl. Transl.); 34: No. 1, 39-40 (Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 31 (Jan 1973).

Breakdowns in radiochemical plants using gamma sources are analyzed and classified. (TFD)

6828 ELECTROSTATIC EFFECTS IN MICROBALANCES. I. GENERAL CONSIDERATIONS OF THE EFFECTIVENESS OF A RADIOACTIVE IONIZING SOURCE UNDER AMBIENT CONDITIONS. Hawley, R.E.; Williams, C.J. (Research and Applications Department, Cahn Instruments, A Division of Ventron Corporation, Paramount, California 90723). J. Vac. Sci. Technol. 11: No. 1, 419-422 (Jan 1974).

This paper discusses the effectiveness under ambient conditions of an α-emitting polonium 210 source in relieving electrostatic charges of approximately -1000 V caused by friction, and what are believed to be "apparent" static charges of at least -2000 V caused by an induced dipole alignment in a dielectric material. It was noted that charges applied on either the exterior or interior of a specially designed microbalance hangdown glass tube could affect the sample basket and could be efficiently alleviated by the α irradiation. Charges of $\sim$ 20 V were found to be sufficient to maintain the sample basket against the wall of the enclosure, while charges of several hundred volts were required for the initial displacement of the sample basket. (auth)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 6069, 6859, 6896, 6958, 6980, and 7009.

6829 (AEC-tr-7471, pp 119-120) RADIOSENSITIVITY OF VARIOUS CONFORMATIONS OF NATIVE DNA IN SOLUTION. Tselikova, S. V.; Leivitman, M. Kh.; Kondakova, N. V. (Inst. of Biological Physics, Pushchino, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 419-420(1973).

The dependence of the radiosensitivity of DNA on its conformational state was investigated. The protective action of 7 M lithium chloride in the γ irradiation of DNA was established according to the criteria of single and double breaks and transforming activity. (tr-auth)

6830 (AEC-tr-7471, pp 121-123) CHEMICAL PROTECTION OF TRANSFORMING DNA. Tselikov, S. V.; Levitman, M. Kh.; Kondakova, N. V. (Inst. of Biological Physics, Pushchino, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 421-422(1973).

The chemical protection of DNA was investigated according to the number of breaks and transforming activity. In contrast to single-stranded breaks, the protection of DNA from double-stranded breaks increases with dose of irradiation, while the protection from loss of transforming activity exceeds the degree of protection from each of the types of breaks. According to all criteria, the achievement of equal protection with β-alanine required a concentration one to two orders of magnitude greater than cystaphos. (tr-auth)

6831 (AEC-tr-7471, pp 129-133) STUDY OF THE DEPENDENCE OF THE RATE OF HYDROLYSIS OF ACETYLCHOLINE ON ITS CONCENTRATION UNDER THE ACTION OF ACETYLCHOLINESTERASE AND WHOLE ERYTHROCYTES, SUBJECTED TO IRRADIATION BY ^{137}Cs. Bondar, A. A. (Veterinary Inst., Leningrad). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 426-429(1973).

On the basis of the change in the kinetic constants of the hydrolysis of acetylcholine (AC) under the action of γ-irradiated acetylcholinesterase (ACE), EC 3.1.1.7 and whole erythrocytes, it is hypothesized that the qualitative properties and quantitative characteristics of the active sites of the enzyme are reduced. Moreover, in the case of ACE of whole erythrocytes, the qualitative characteristics are more reduced, while in the case of an ACE preparation, the quantitative characteristic is more reduced. The decrease in the relative activity of irradiated ACE at AC concentrations above the optimum is explained from the standpoint of enhancement of the allosteric interaction of the substrate with the enzyme during irradiation. (tr-auth)

6832 (AEC-tr-7471, pp 134-138) RADIOLYSIS OF UNSATURATED FATTY ACIDS. Mochalina, A. S.; Klimova, T. P. (Inst. of Biophysics, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 430-433(1973).

A study of the radiolysis of linoleic and linolenic acids after irradiation with the γ rays of ^{60}Co has shown that the radiation chemical yield of hydroperoxides depends on the acid concentration, the degree of unsaturation of the molecule, the dose of irradiation, and the dose rate. The formation of water-soluble radiolysis products, absorbing at 225 mμ and reacting with thiobarbituric acid (TBA), was established. The chromatographic separation of water-soluble products showed the presence of a mixture of the various compounds. (tr-auth)

6833 (AEC-tr-7499, pp 1-8) COMPARATIVE INVESTIGATION OF SUPERMOLECULAR COMPLEXES OF CHROMATIN DNA IN THE SPLEENS AND LIVERS OF RATS IN THE CASE OF CHRONIC AND SINGLE GAMMA IRRADIATION. Strazhevskaya, N. B.; Korol, B. A.; Kolesnik, P. K.; Minaev, P. F. (Inst. of Biological Physics, Pushchino, USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 483-488(1973).

The influence of a single γ irradiation of rats (1 kR) and chronic γ irradiation (4.8 R daily for 10 months, summary dose 980 R) was compared. Chronic irradiation induces distinct changes in the structure of the nuclear chromatin in the spleen—a 29% decrease in the elastoviscosity of the supermolecular DNA and a 27% increase in the strength of the DNA-acid protein bond. No such effects were observed in the liver. The process of natural aging of the organism is accompanied by a strengthening of the DNA-acid protein bond in DNP, especially in the spleen. It is suggested that chronic irradiation accelerates the process of natural aging of the organism at the molecular and supermolecular levels. Immediately after a single irradiation, a substantial increase in the strength of the DNA-acid proteins bond is noted both in the spleen (42%) and in the liver (31%). A repair of DNP is observed in the liver 2 and 6 hrs after irradiation, while post-radiation secondary degradation of the complex occurs in the spleen. (tr-auth)

6834 (AEC-tr-7499, pp 33-38) INVESTIGATION OF THE INFLUENCE OF X IRRADIATION OF GLOBULAR ACTIN ON THE PROPERTIES OF ITS MONOLAYERS. Egiazarova, A. R.; Nadareishvili, K. Sh. (Inst. of Physiology, Tbilisi, USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 508-512(1973).

It was found that the irradiation of a solution of globular actin at a dose of 0.65 and 6.5 kR causes a decrease in the elasticity, the viscosity, as well as the area of a monolayer obtained on the liquid-air interface. Under the same conditions, the interfacial potential drop of the monolayer remains constant. (tr-auth)

6835 (AEC-tr-7534, pp 4-9) SPECTROPHOTOMETRIC EVALUATION OF THE PHOTOCHEMICAL CHANGES IN HEMOGLOBIN. Artyukhov, V. G.; Kulakov, V. N.; Shmelev, V. P. (Voronezh State Univ., USSR). May 1974. Translated from Radiobiologiya; 13: No. 6, 813-817(1973).

The electronic absorption spectra (after uv irradiation) of certain forms of hemoglobin in various solvents were investigated. The oxidation of iron in irradiated hemoglobin occurs only in aqueous medium. When oxyhemoglobin is irradiated in glycerin, potassium formate, and glucose, reversible dissociation of oxygen is observed. The oxidized forms of hemoglobin (methemoglobin) are reduced after the influence of uv radiation. (tr-auth)

6836 (COO-3133-10) PROGRESS REPORT ON ORGANIZATIONS AND EVOLUTION OF MULTIPLE GENE COMPLEXES THAT SPECIFY MAJOR RNA COMPONENTS. Atwood, K. C. (Columbia Univ., New York (USA)). 1973. Contract AT(11-1)-3133. 10p. Dep. NTIS $4.00.

6837 (COO-3286-10) STUDY OF THE EFFECTS OF RADIATION ON NUCLEIC ACIDS AND RELATED COMPOUNDS. Progress Report, August 15, 1973–August 14, 1974. Wang, S. Y. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Biochemistry). 1974. Contract AT(11-1)-3286. 13p. Dep. NTIS $4.00.

Ionizing radiation produces genetic effects in biological systems. Since genetic effects are usually the result of modification of DNA or sometimes, of RNA, a great deal of interest is being centered on the chemical and physical nature of radiation-induced lesions to nucleic acids and their components under various conditions. The results of these investigations revealed the enormous complexity of chemical events in these systems and the possible degradation of nucleic acids by strand breakage. Therefore, work in the ionizing radiation of DNA and its components proceeded along a dual course. Chemical changes were characterized on the molecular level for a number of primary radiation products, and strand breakage was investigated intensively as a direct primary event. A nucleoside, 5-hydroxy-6-hydroperoxy-5, 6-dihydrothymidine (TOOH), the major product resulting from γ irradiation of aqueous solutions of thymidine, was isolated and identified. TOOH caused chemical modifications of pyrimidine bases and resulted in changes leading to the production of DNA chain breakage and chromosomal or chromatid aberration of cells. It was concluded that the effects of TOOH are radiomimetic, and they are being studied as a possible mediator of radiobiological effects. (CH)

6838 INFLUENCE OF L.E.T. AND DOSE RATE ON THE DEFERRED RADIOLUMINESCENCE OF ACETONE. Kroh, J.; Wypych, M. (Politechnika Lodzka, Poland). Int. J. Radiat. Phys. Chem.; 6: No. 1, 67-70(Feb 1974).

The influence of LET and dose rate on the isothermal radioluminescence (I.T.L.) and radiothermoluminescence (R.T.L.) of acetone was investigated. The increase of LET or dose rate is followed by the decrease of R.T.L. and simultaneous increase of I.T.L. (auth)

6839 INHIBITION OF THE EXR GENE-DEPENDENT BRANCH OF THE DNA EXCISION REPAIR SYSTEM IN ESCHERICHIA COLI K-12 BY 2,4-DINITROPHENOL. Van der Schueren, E.; Smith, K. C. (Stanford Univ., CA). Phys. Med. Biol.; 19: No. 2, 95-102(Feb 1974).

Ultraviolet (uv)-irradiated E. coli K-12 wild-type cells were sensitized by a post-irradiation treatment with 10^{-2} M 2,4-dinitrophenol (DNP). This effect was not seen in strains carrying a uvr mutation, suggesting that DNP interferes with the excision

repair process. The polA strain was sensitized to the same extent as the wild-type strain, while the exrA strain was not affected by DNP treatment. Recombination deficient strains (recA, recB and recA recB) were protected by DNP treatment after uv irradiation. This protection was abolished by the addition of a uvr mutation (i.e., in strains recA uvrB and recB uvrB). Alkaline sucrose gradient sedimentation studies showed that DNP treatment interfered with the rejoining of DNA single-strand breaks induced by the excision repair process. This interference was apparently specific for the exr gene-dependent branch of the uvr gene-dependent excision repair process, since the uvr and exr strains were not sensitized while the wild-type and polA strains were sensitized. (auth)

6840 IN VITRO PHOTOREACTIVATION OF ULTRAVIOLET-INACTIVATED RIBONUCLEIC ACID FROM TOBACCO MOSAIC VIRUS. Hurter, J. (Washington Univ., Seattle); Gordon, M. P.; Kirwan, J. P.; McLaren, A. D. (Washington Univ., Seattle). Photochem. Photobiol.; 19: No. 3, 185-190(Mar 1974).

Treatment of ultraviolet-inactivated tobacco mosaic virus ribonucleic acid (TMV-RNA) with extracts obtained from the local lesion host, Nicotiana tabacum var. Xanthi, n.c., and simultaneous illumination at 365 nm resulted in up to a four-fold increase in infectivity over non-illuminated controls. The active material in the extract appeared to be associated with protein, based on its inactivation by boiling, precipitation with ammonium sulfate, and exclusion from Bio-Rad P100 polyacrylamide. Partially purified DNA photoreactivating enzyme from yeast or pinto bean had no activity on ultraviolet-irradiated TMV-RNA. (auth)

6841 INVESTIGATING THE POSSIBILITY OF REPAIRING NORMAL AND 5-BROMURACIL-SUBSTITUTED DNA IN VITRO. Daneva, M. A.; Marinova, Ts. I.; Petrova, S. N.; Todorov, S. L. Compt. Rend. Acad. Bulg. Sci.; 27: No. 1, 105-108(1974).

The action of the extract from M. lysodeikticus on biological activity of DNA from B. subtilis irradiated with ultraviolet rays was studied and its effects on normal and 5-bromouracil sensitized DNA were compared. Results show that the extract causes partial restoration of the biological activity damaged at the irradiation in both the normal DNA and in the 5-bromouracil-substituted DNA, the latter being influenced to a smaller extent. (LK)

6842 RADIOLYSIS OF AQUEOUS SOLUTIONS OF HOMOCYSTEINETHIOLACTONE HYDROCHLORIDE. Anderson, R. F.; Packer, J. E. (Univ. of Auckland, New Zealand). Int. J. Radiat. Phys. Chem.; 6: No. 1, 33-46(Feb 1974).

The homocysteinethiolactone cation reacts rapidly with e^-_{aq} ($k = 3.7 \times 10^{10}$ dm^3 mol^{-1} s^{-1}) producing ammonia and a radical that decays by second-order kinetics in deoxygenated solutions and by pseudo first-order kinetics in the presence of oxygen. The nature of this radical is discussed, and it appears that reductive deamination does not involve appreciable ring opening. In N_2O saturated solution OH radicals give an intermediate that decays by second-order kinetics and leads to oxidative deamination with $G(NH_3) = \frac{1}{2}(G_{OH} + G_{e^-_{aq}})$. H atoms do not react with HCTL. (auth)

6843 MEASUREMENT OF DEFECTS IN ULTRAVIOLET-IRRADIATED DNA BY THE KINETIC FORMALDEHYDE METHOD. Rahn, R. O.; Stafford, R. S. (Oak Ridge National Lab., TN). Nature (London); 248: No. 5443, 52-54(1 Mar 1974).

It is stated that UV irradiation of DNA converts a portion of the adjacent pyrimidine bases into cyclobutane dimers, and as a consequence H-bonding and base stacking at these sites are disrupted and localized denatured regions (defects) may appear. Treatment of the DNA with HCHO results in a preferential reaction at these denatured sites since the HCHO reacts only with free, but not H-bonded, amino groups, and the rate of reaction of HCHO with DNA may be related to the concentration of defects in the DNA. Since HCHO unwinds the DNA as it reacts, the rate of reaction can be followed by determining the charge in helicity from the change in spectrophotometric absorbance. Defects can be single or double strand chain breaks or pyrimidine dimers, and there is experimental evidence that the velocity of unwinding at a defect site is the same for both single and double strand breaks, but there is little direct evidence to support the assumption that this velocity is the same for pyrimidine dimers as for chain breaks. Experiments are described to endeavor to test the assumption that dimers and chain break defect sites react with formaldehyde at the same rate, and from the results it was concluded that chain breaks and dimers react with different velocities, and the HCHO reaction is more likely to occur at a chain break than at a dimer. Similar conclusions were reached by other workers for γ-irradiated DNA. (UK)

6844 DISCRIMINATION OF THE EFFECTS OF TRANSMUTATION FROM THOSE OF IRRADIATION AFTER INCORPORATION OF RADIONUCLIDES INTO THE DNA. Hamann, H. J. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Hanover). (1973). vp. (In German).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

The general feasibility of and preliminary experiments for the discrimination of transmutational from radiation effects after incorporation of ^{3}H, ^{14}C, and ^{32}P into the DNA are discussed. Attempts have been made to calculate the γ radiation which, after penetration into a water-filled semi-unlimited irradiation vessel, produces an energy absorption spectrum in the cell nuclei of the root tips of Vicia faba that is similar to that of the beta particles of the radionuclide incorporated into the DNA. This approximation has been thought to be feasible by superimposition of monoenergetic gamma radiation. The spectra have been calculated by the Monte-Carlo method. It proved to be difficult, and in some cases even impossible, to simulate the energy absorption of the beta particles, but experiments to approximate the absorption spectra of ^{14}C and ^{131}I have been more or less successful. Another experiment described here is the investigation of the relative contribution of decay event and beta radiation in the formation of single and double strand breaks in single-strand ^{32}P-labeled DNA. The breaks in the labeled strand are expected to be mainly due to the transmutation event, whereas the breaks in the unlabeled strand are thought to be caused by the radiation of the emitted beta particles. The number of breaks can be determined by means of the preparative ultracentrifuge. Experiments on the DNA of the phages P^{22} and PBSH are reported. (GE)

6845 REPAIR OF DAMAGE IN DNA MOLECULES CAUSED BY DISINTEGRATION OF INCORPORATED INTO DNA RADIOPHOSPHORUS ATOMS. II. Assay by Physico-Chemical Methods. Jagusztyn-Krynicka, K.; Kunicki-Goldfinger, W. J. H. (Univ., Warsaw). Acta Microbiol. Pol., Ser. A; 6: No. 1, 11-22(1974).

The ^{32}P damage in R factor DNA and its repair were assayed in minicells by calculation of a fraction of covalently closed circular (CCC) DNA in alkaline sucrose gradient sedimentation. It was shown that conversion of CCC DNA into slower sedimenting components, as well as inactivation of R factor transfer ability, are caused by unrepaired single-strand breaks. There are two mechanisms of repair of single strand breaks produced by ^{32}P disintegration. The rapid repair, which may be identical or related to rapid repair of x-ray damage mediated by pol 1 gene, is as efficient in dar_1^- and dar_3^- mutants as in wild type. It is so rapid that about 50% of single-strand breaks are repaired before sedimentation analysis is performed. The slow repair, that may be related to slow repair of x-ray damage controlled by rec A gene, is completed after more than one hour incubation. The slow repair of damaged R factor DNA in minicells is less efficient than in the bacterial cell; it is absent in dar_1^- mutant. It is suggested that the slow repair activity is connected with bacterial chromosome, in minicells (i.e. in the polar regions of cells) its amount is limited and is enough to repair ca 5 lesions per molecule. In dar_1^- mutant this activity is lacking in extrachromosomal regions of the cell. (auth)

6846 MECHANISM OF CONJUGATION AND RECOMBINATION IN BACTERIA. XIII. Heterogenetic Recombinant Clones and the Fate of Transferred Fragment of Hfr Chromosome. Najer, A.; Kunicki-Goldfinger, W. J. H. (Univ., Warsaw). Acta Microbiol. Pol., Ser. A; 6: No. 1, 23-36(1974).

Heterogeneity of recombinant clones has been confirmed in crosses with H type of Hfr cells. The heterogeneity is susceptible to inactivating action of decay of ^{32}P atoms incorporated in transferred fragment of Hfr chromosome. The possible mechanism of formation of heterogenic clones are discussed. It is concluded that the heterogeneity of recombinant clones is due to repeated recombinations between the recombinant chromosome and the preserved fragment of transferred donor DNA. The fragment is inactivated gradually and only a small fraction of transferred fragments may replicate. (auth)

6847 REPAIR OF DAMAGE IN DNA MOLECULES CAUSED BY DISINTEGRATION OF INCORPORATED INTO DNA RADIOPHOSPHORUS ATOMS. I. Assay by Biological Methods. Jagusztyn-Krynicka, K.; Kunicki-Goldfinger, W. J. H. (Univ., Warsaw). Acta Microbiol. Pol., Ser. A; 6: No. 1, 1-10(1974).

Damage in F'lac DNA produced by decay of ^{32}P was measured by decrease of the ability of the episome to be transferred into the recA$^-$ recipient and replication therein. The damaged F'lac was transferred into the recipient immediately after decay of ^{32}P (control), and after repair during incubation of labeled donor cells at 37° before mating. UV-sensitive mutants, dar_1^- and dar_3^-, are not more sensitive to ^{32}P decay than the wild type strain. Repair of ^{32}P damage in F'lac DNA is efficient in the wild type strain and in dar_3^- mutant. Repair activity in dar_1^- mutant is very low. All inactivation events are repaired in wild type and dar_3^- mutant, if a fraction of decayed ^{32}P atoms does not exceed 0.5. The in-

activation curves, after repair process is completed, have a typical sigmoidal form. (auth)

6848 BINDING OF NITROXYLS TO RADIATION-INDUCED DNA-TRANSIENTS IN E. COLI K-12 UNDER IN VIVO CONDITIONS AND ITS RELEVANCE FOR RADIOSENSITIZATION. Wold, E.; Brustad, T. (Norsk Hydros Institutt for Kreftforskning, Oslo). Int. J. Radiat. Biol.; 25: No. 3, 225-233(Mar 1974).

Binding of tritiated 2,2,6,6-tetramethyl-4-piperidone-N-oxyl (^{3}H-TAN) to radiation-induced DNA-transients in E. coli K-12 strain AB 2463 rec$^-$A, was studied under in vivo conditions. In N_2O-saturated cell suspensions 30% higher yield was observed than in N_2. Aerobic bacteria showed slight binding ability. The time-course of the ability of TAN to (a) form complexes with DNA and (b) act as an anoxic cell radiosensitizer was investigated when TAN was added to the cell suspension at different times before and after irradiation. When TAN was added before exposure, the yield of TAN-DNA complexing was reduced by only 40% when the contact time was reduced from 10 min to 200 msec. For contact times as short as 200 msec, however, only a minute radiosensitization was observed. When TAN was added after exposure, there were significant binding yields when mixing occurred within 2 sec after irradiation of the cell suspension. No sensitization at all resulted, however, even when TAN was added only 200 msec after exposure. The difference in time-course for binding and sensitization was discussed and a model for the sensitization mechanisms suggested. (auth)

Radiation Effects on Cells

Refer also to abstracts 6896 and 6958.

6849 (AEC-tr-7471, pp 47-54) RADIOMODIFYING EFFECT OF HYDROXYUREA ON HeLa CELLS IN THE LOG AND STATIONARY PERIODS OF GROWTH. Maksumova, Z. A.; Afanas'ev, G. G.; Pelevina, I. I. (Andizhansk State Medical Inst.). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 361-367(1973).

The reaction of HeLa cells in the logarithmic and stationary periods of growth to irradiation and the influence of an inhibitor of DNA synthesis—hydroxyurea (HU)—were studied. In the stationary period of growth, the bulk of the cells was evidently in the G_0 phase, while a small fraction are in the G_2 phase of the cell cycle; in this state the population is less sensitive to the influence of HU. When HU is added immediately after irradiation, the survival of an exponentially multiplying population decreases, whereas the survival of cells in the stationary period of growth increases. These changes are not correlated with the change in DNA synthesis which decreases monotypically in both cases. (tr-auth)

6850 ANALYSIS OF INTERPHASE CHROMOSOME DAMAGE BY MEANS OF PREMATURE CHROMOSOME CONDENSATION AFTER X- AND ULTRAVIOLET-IRRADIATION. Waldren, C. A.; Johnson, R. T. (Cambridge Univ., Eng.). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 4, 1137-1141(Apr 1974).

Sendai virus-mediated fusion between mitotic and interphase mammalian cells causes the rapid condensation of the interphase chromosomes into distinct structures, a process termed premature chromosome condensation. This phenomenon has been used to assess the immediate action of x rays and ultraviolet light on the chromosomes of HeLa cells irradiated in the G1 phase of the life cycle. X-irradiation produces fragmented chromosomes; but even the most finely chopped fragments retain the condensed morphology characteristic of the premature chromosome condensation of unirradiated G1 cells. For doses up to about 1800 rads, the increase in the number of fragments is linearly related to the dose. One mean lethal dose (about 100 rads) yields a net increase of 10–15 fragments per G1 cell, which is considerably larger than previous estimates based on scoring of mitotic chromosomes. Incubation of irradiated cells produces a rapid (within 2 hr) reduction in the number of fragments, indicative of a rejoining process. The decrease in the number of pieces is not accompanied by unscheduled DNA synthesis detectable by radioautography. G1 chromosomes of cells irradiated with UV light in G1 phase are not appreciably fragmented but are elongated and attenuated so that they resemble the premature-chromosome-condensation chromosomes of unirradiated S-phase cells. Both the degree of S-like character attained by the G1 chromosomes in a cell and the percentage of the cell population displaying the G1 → S transition increase with the dose and incubation time after irradiation. Thus, in contrast to the immediate manifestation of damage from x-rays, the maximum induction of the S-like state does not occur until about 2 hr after irradiation. The S-like chromosomes are capable of unscheduled DNA synthesis. (auth)

6851 RNA BIOSYNTHESIS AS A PARAMETER FOR MEASURING PHOTOREACTIVATION. Chakraborty, B.; Biswas, N.; Reogy, R. K. (Chittaranjan National Cancer Research Centre, Calcutta). Indian J. Exp. Biol.; 11: No. 5, 443-444(Sep 1973).

Cell damage under uv light and its subsequent recovery under visible light were investigated by incorporation of ^{32}P in RNA. The results show that ^{32}P incorporation in RNA may be used as a parameter for measuring both cell damage and recovery. (auth)

6852 BIOMEDICAL APPLICATION OF HEAVY-IONIZING PARTICLE. Matsuyama, A.; Takahashi, T.; Karasawa, T.; Yatagai, F. (Inst. of Physical and Chemical Research, Wako, Japan). Tokyo Igaku; 80: No. 2, 126-144(Sep 1972). (In Japanese).

The inactivating effects of heavy-ionizing particles on cultured animal cells and bacterial cells were reviewed in order to study the biomedical application of heavy-ionizing particles. The lethal action of the rays on cells and the analytic results are presented with reference to literature. American investigators have cited that high energy nitrogen ions, which can now be successfully accelerated, may be a possible treatment for cancer cases. Methods of accelerating heavy-ionizing particles, the substance of the particles, and their interaction are discussed. The lethal action of α rays and heavy-ionizing radiation on human kidney Ti cells was compared with that of x rays. In addition, the effects of α-rays, carbon ions, nitrogen ions, and oxygen ions accelerated by cyclotron in Institute of Physical and Chemical Research in Japan on bacterial cells and cultured animal cells were compared. Target theory was applied to the action of heavy ions, in order to explain the inactivation of enzymes, viruses, and cells produced by radiation. Using this as a basis, various theories were introduced concerning inactivation of heavy ions. (JA)

6853 INVESTIGATIONS OF THE MECHANISMS OF DAMAGE AND REPAIR IN H. Ep. 2 CELLS FOLLOWING IRRADIATION WITH ULTRAVIOLET LIGHT AND X RAYS. Landeck, A. Berlin; Freie Univ. (1972). 153p. (In German).

Thesis.

Studies on the colony forming ability of uv-irradiated H. Ep. 2 cells have led to the detection of a repair mechanism in such cells that can be inhibited by caffeine and hydroxyurea. In x-irradiated cells, this inhibition has been achieved by hydroxyurea only. In most of the cases, this inhibiting effect has been observable for the first few hours following irradiation. It is shown that H. Ep. 2 cells are capable of eliminating uv-induced pyrimidine dimers, and that this elimination cannot be inhibited by caffeine or hydroxyurea. Following uv irradiation, a release of radioactivity through ^{3}HTdR-labeled cells to the incubation medium and an unscheduled incorporation of ^{3}H–TdR in hydroxyurea-containing medium into the acid insoluble fraction of the cells have been detected, whereas in x irradiation, these processes have been observed only after application of high doses (5,000 rad). The release of radioactivity to the incubation medium has been interpreted as radiation-induced DNA degradation, and the incorporation of ^{3}H–TdR into the acid insoluble fraction in the presence of hydroxyurea as unscheduled DNA synthesis. Caffeine and hydroxyurea proved to have no effect on DNA degradation, and there has been no evidence for an inhibition of DNA synthesis under the influence of caffeine. The conclusion to be drawn from these results is that H. Ep. 2 cells are capable of repairing both uv- and x-ray-induced damage. But the repair of the uv-induced and x-ray-induced damage seems to proceed via at least partly independent mechanisms. (GE)

6854 CHOLINE ACETYLTRANSFERASE LEVEL IN CYCLIC AMP AND X-RAY INDUCED MORPHOLOGICALLY DIFFERENTIATED NEUROBLASTOMA CELLS IN CULTURE. Prasad, K. N.; Mandal, B. (Univ. of Colorado, Denver). Cytobios; 8: No. 29-30, 75-80(Sep 1973).

Choline acetyltransferase (ChA) markedly increased in morphologically differentiated cells induced by dibutyryl cyclic AMP, prostaglandin E_1, 4-(-3-butoxy-4-methoxybenzyl)-2-imidazolidinone, papaverine, 8-benzylthio 3′, 5′-cyclic AMP, and x ray (600 rad). However, some agents such as 5′ AMP and butyric acid (sodium salt) that inhibit cell division without causing morphological differentiation also increased ChA activity. ChA activity did not change during confluent phase of growth. 3′, 5′ cyclic AMP which does not influence the growth rate of this clone had no effect on the basal level of enzyme. Gamma-aminobutyric acid which does not affect the growth or morphology had no effect on ChA level. The levels of ChA in control and dibutyryl cyclic AMP treated cells were insensitive to cycloheximide and actinomycin D. Data indicated that the morphological differentiation and regulation of ChA are independently regulated, and the latter may be linked with the inhibition of cell division. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 6839, 6840, 6848, 6852, 6890, 6895, 6896, 6958, 7019, 8977, and 8986.

6855 (AEC-tr-7471, pp 33-39) INDUCTION OF MUTATIONS AND REPAIR IN THE SYSTEM PHAGE LAMBDA–E. COLI DURING ULTRAVIOLET IRRADIATION. Polukhina, G. N.; Ravin, V. K. (Inst. of General Genetics, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 349-354(1973).

At equal doses of irradiation, the frequency of induction of C-mutations in phage λ is the same in the case of inoculation onto strains uvr^+ and uvr^-; calculated per lethal hit, the mutation frequency is higher for the strain uvr^-. No induction of mutations was detected in the case of inoculation onto the strain $RecA^-$. In the case of infection of irradiated cells with phage λ, an increase in the frequency of C-mutants is noted in the case of the strains uvr^+ and $RecA^-$; in the case of the strain uvr^-, no induction of mutations was noted. An analogous phenomenon is observed in the case of infection of the cell with phages λ and λ^{434}. It is suggested that in addition to the basic mechanism of UV mutagenesis, associated with the Rec enzymes, there is another mechanism, operating with photoproducts excised from DNA. (tr-auth)

6856 (AEC-tr-7471, pp 159-163) PHENOMENOLOGICAL PECULIARITIES OF THE PHOTOMODIFICATION OF RADIATION DAMAGE IN THE BLUE–GREEN ALGA PLECTONEMA BORYANUM. Kutlakhmedov, Yu. A.; Grodzinskii, D. M. (Inst. of Plant Physiology, Kiev). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 448-451(1973).

The possibility of modification of the radiosensitivity of the blue-green alga Plectonema boryanum with visible light was studied. An appreciable increase in the survival was detected under the simultaneous influence of visible light and γ radiation (photomodification). The phenomenological peculiarities of photomodification (PM) were studied: the kinetics of PM, the effect of the time of light influence (before and after irradiation) on it, the action spectrum, the influence of the age of the algal culture, the radiobiological characteristics of PM, and the temperature dependence. Possible mechanisms of photomodification are discussed. (tr-auth)

6857 (JAERI-M-5249) STERILIZATION OF LABORATORY ANIMAL DIETS BY IONIZING RADIATION. Ito, H.; Iizuka, H.; Sato, T. (Japan Atomic Energy Research Inst., Tokyo). May 1973. 9p. (In Japanese). NTIS (U. S. Sales Only).

Sterilization by gamma irradiation of various laboratory animal diets is described. The sterilization of pellets is successfully achieved with doses as low as 2 Mrad by an inoculation technique, using thioglycollate medium. A few positive samples are observable at a dose of 1.5 Mrad, the number increasing with decrease of the dosage. The organisms surviving over 1.0 Mrad are mostly spore-forming bacteria such as Bacillus spp; and some gram positive cocci and gram negative in chains or filamentous bacterium are also observed. A radiation dose of 2.5 Mrad is effective for sterilization of dried test pieces such as Bacillus pumilus E601 and Streptococcus faecium A_T1, which are the recommended microbiological reference standards of medical products. Radiation doses of 2.5 to 3.5 Mrad, obtained from the sterilization curve of animal diets, appear to be desirable for sterilization of the animal diets. (auth)

6858 (ORO-3408-21) PROGRESS REPORT AND RENEWAL REPORT. Powers, E. L. (Texas Univ., Austin (USA). Lab. of Radiation Biology). 1974. 28p. Dep. NTIS $4.50.

Progress is reported on studies on the role of water-derived free radicals in the radiosensitivity of bacteriophages, bacteria, and spores in aqueous suspensions. Emphasis was on physical and chemical events that follow energy absorption but are antecedent to the expression of biological damage. A list is included of 40 papers published to date that report the findings in detail. (CH)

6859 (SGAE-2246) EFFECT OF TWEEN 80 ON DNA-REPAIR IN E. COLI B/rT^- AFTER EXPOSURE TO GAMMA-RAYS. Turanitz, K.; Stehlik, G.; Hammerschmid, F.; Delac, M. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Feb 1974. 13p. (In German). (CONF-731215-2). Dep. NTIS (US Sales Only) $4.00.

From international symposium on DNA-repair and late effects; Vienna, Austria (6 Dec 1973).

Escherichia coli B/rT^- was used to study the effect of Tween 80 (2 hour incubation in 0.002 percent solution) on the total DNA-repair process after exposure to γ rays. The mutant E. coli B/rT^- was able to repair DNA damages after 2.5 krad (^{60}Co) within 25 minutes in such a way that this DNA showed no difference in its gradientultracentrifugation pattern as compared with the control DNA; DNA damages after 20 krad were repaired only to about 80 percent as compared to the control sample. It was found that even at this low concentration Tween 80 reduces the velocity as well as the total amount of DNA-repair. After irradiation with 30 krad ^{60}Co and a repair period of 25 minutes (37°C, in darkness) radiation-damaged DNA in phosphate buffer (M9) was repaired to only 50 percent in samples preincubated with 0.002 percent Tween 80, as compared to irradiated control samples without Tween 80. (auth)

6860 MODIFYING EFFECT OF AMINO ACIDS, PURINES AND PYRIMIDINES, AND VITAMINS ON THE SENSITIVITY OF ASPERGILLUS CHEVALIERI (MANGIN) TO UV RAYS. Nanda, G.; Nandi, P.; Mishra, A. K. (Bose Inst., Calcutta). Trans. Bose Res. Inst. (Calcutta); 35: No. 2, 25-30(Jun 1972).

Modifying effect of environmental and cultural conditions on the mutagenic properties of the uv radiation was investigated by pre-, post-, and during irradiation treatment with amino acid mixture, nucleic acid hydrolysates, and vitamin solution. In all cases the treatments exerted influence on mutation frequencies in Aspergillus chevalieri. But there was no significant qualitative difference between mutants isolated from pre-, post- or during irradiation treatments. The highest percentage of mutations occurred in case of treatment with vitamin solution. (auth)

6861 EFFECTS OF NON-IONIZING AND IONIZING RADIATIONS ON THE TRANSFORMING ABILITY OF E. COLI DNA. Ranade, S. S.; Avadhani, N. G.; Rege, D. V. (Bombay Univ.). Photochem. Photobiol.; 19: No. 2, 103-108(Feb 1974).

A transformation system in Escherichia coli was employed to verify the extent of the lesions caused by ultraviolet (uv) and ionizing radiations. DNA inactivated at 280 nm could be reactivated to some extent by exposing the transforming DNA solutions at 240 nm. This reactivation has been tested using more than one strain of E. coli as recipient. Transforming DNA inactivated by ionizing radiations (^{90}Sr beta rays and ^{60}Co gamma rays) was not reactivable. Low doses of beta rays, however, reactivated the DNA inactivated by 280 nm uv to a slight but significant extent. (auth)

6862 FORMATION OF PHOTOREVERSIBLE CYCLOBUTANE TYPE PYRIMIDINE DIMERS IN ULTRAVIOLET-IRRADIATED POTATO VIRUS X. Huang, C. W.; Gordon, M. P. (Univ. of Washington, Seattle). Photochem. Photobiol.; 19: No. 4, 269-272(Apr 1974).

Photoreversible cyclobutane-type pyrimidine dimers were found in ^{32}P-labeled RNA isolated from intact potato virus uv-irradiated with 254 nm light. The number of dimers was correlated with the biological infectivity of the ultraviolet-treated virus. Assuming that incorporated ^{32}P is homogeneously distributed in the viral RNA chain, it can be calculated that about 5.7 ± 1.7 dimers are present in each strand of virus per lethal biological hit. (auth)

6863 CORRELATION OF PHOTOREACTIVATION OF ULTRAVIOLET-INDUCED KILLING WITH DIMER SPLITTING BEFORE AND AFTER DNA REPLICATION IN AN EXCISION-LESS STRAIN OF ESCHERICHIA COLI. Kondo, S.; Ikenaga, M.; Jagger, J. (Univ. of Texas, Dallas). Photochem. Photobiol.; 19: No. 4, 261-267(Apr 1974).

Splitting of thymine-containing dimers was compared quantitatively with photoreactivation (PR) of killing induced by ultraviolet radiation (254 nm) in a $uvrA^-$ (excisionless) strain of E. coli. Immediately after irradiation, the splitting rate (number of dimers split/genome/unit PR dose) agreed well with the PR rate of the cells (rate of recovery from photoreactivable lethal damage converted into an estimated number of dimers split/genome/unit PR dose). After 4 h of incubation of cells in nutrient medium, the maximal fraction of splittable dimers decreased, as did the maximal fraction of photoreactivable lethal damage. However, the initial splitting rate after incubation was equal to that before incubation. During the 4 h incubation, the heavily irradiated $uvrA^-$ cells did not divide but became filamentous and their DNA increased about 70%. It is concluded that roughly half of the dimers in DNA that has replicated after ultraviolet irradiation are split as efficiently as those in DNA that has not replicated. (auth)

6864 DOSE-RATE EFFECT IN THE ULTRAVIOLET INACTIVATION OF BACTERIAL SPORES. Powers, E. L.; Cross, M.; Varga, C. J. (Univ. of Texas, Austin). Photochem. Photobiol.; 19: No. 4, 273-276(Apr 1974).

The importance of dose rate in determining the efficiency of ionizing radiation in biological organisms is widely appreciated although this parameter has been given little attention in the numerous studies on mechanisms of biological action of ultraviolet radiation. The photobiology of the bacterial spore sys-

tem Bacillus megaterium has been studied and is discussed. The need for control of the dose rate following inconsistencies between experiments with slightly different geometries is stressed. It was found that not only total input of 254 nm light into the cell, but also, in certain ranges for certain stocks, the rate at which the energy is deposited determines the degree of response. (UK)

6865 EFFECT OF γ RADIATION AND STORAGE ON THE BIOCHEMICAL AND TECHNOLOGICAL PROPERTIES OF SOME PAKISTANI WHEAT VARIETIES. Ahmad, M.; Hussain, A.; Nadeem, M. T.; Sattar, A. (Nuclear Inst. for Agriculture and Biology, Lyallpur, Pakistan). Pak. J. Sci. Ind. Res.; 16: No. 3-4, 132-136(1973).

The effect of gamma radiation (10 to 1000 krad) and storage (one year) on C-591 and Mexi-Pak wheat varieties was studied. Biochemical parameters investigated were moisture, ash, fat, sugars, protein, gluten (fresh and dry), amino acids, fat acidity, and protein solubility. Bread making and roti making properties of irradiated and unirradiated wheat were also studied. It is concluded from this investigation that gamma doses up to 100 krad have no adverse effect on both varieties of wheat and the irradiated wheat remains wholesome from biochemical, technological, and organoleptic points of view during storage period of one year. (auth)

6866 COMPARATIVE STUDIES OF THE MUTAGENIC EFFECTS OF EXTERNAL β IRRADIATION AND OF INCORPORATED RADIOPHOSPHORUS (^{32}P) ON HAPLOID CELLS OF YEAST AND ON THE NATURE OF MUTATIONS INDUCED BY THESE AGENTS. Korolev, V. G.; Gracheva, L. M.; Bolotnikova, E. V. (Leningrad Inst. of Nuclear Physics). Genetika; 10: No. 3, 111-119(Mar 1974). (In Russian).

The object of these studies was the induction of mutations in haploid cells of yeast (Saccharomyces cerevisiae) by the external β irradiation and by the decay of incorporated ^{32}P. The mutagenic effect of β rays was compared to that of the decay of ^{32}P reduced to the equivalent dose per cell nucleus. As it was shown by the results of the experiments, the share of external β irradiation in the total effect of self-irradiation by β particles and transmutations was about 8%. One hundred and fifty adenine-dependent mutants, induced by ^{32}P and 200 ade mutants, induced by external β irradiation, were tested for interallelic complementation. The ratio of the frequencies of $ad_1 : ad_2$ mutants were 1:2 and 1:2.5 for ^{32}P and external β irradiation, respectively. It was shown by the investigation of the nature of mutations induced by ^{32}P and by external β irradiation, that the most of ^{32}P induced mutants (95%) and those induced by β rays (82%) were related to the exchange of base pairs. (auth)

6867 UV-SENSITIVITY OF THE STRAINS CARRYING MUTATIONS IN POL A AND UVR E GENES. Smirnov, G. B. (Inst. of Epidemiology and Microbiology, Moscow). Genetika; 10: No. 3, 131-134(Mar 1974). (In Russian).

The uv-sensitivity of the double mutant uvr E 502 pol A 12 was compared with that of the component single mutants and wild type strain. All these strains were incubated after uv irradiation at 30°C. It was found that the effects of the uvr E 502 and pol A 12 mutations on the uv-sensitivity were additive. The same result was obtained when the effects of the uvr E 502 mutation and genetically suppressed pol A 12 mutation on the uv-sensitivity were studied at 37°C. It was suggested that DNA polymerase I and the uvr E^+ gene product could partially substitute for each other in performing of the hydrolysis-resynthesis step of excision repair. (auth)

6868 ENHANCEMENT OF RADIATION LETHALITY OF E. COLI B/r BY PROCAINE HYDROCHLORIDE. Shenoy, M. A.; Singh, B. B.; Gopa-Ayengar, A. R. (Bhabha Atomic Research Centre, Bombay). Nature (London); 248: No. 5447, 415-416 (29 Mar 1974).

It is stated that many carbonyl compounds, due to the electron affinitive property of their C = 0 groups, are good radiosensitizers in bacterial and mammalian cells. The electronic charge distribution at the carbonyl bond of some ester local anesthetics is also known to play an important role in their anesthetic action, and if these esters are found to be radiosensitizers they may prove valuable in radiation therapy. A study is described on one such compound, procaine hydrochloride, commonly used as a local anesthetic. It was found to enhance the radiation lethality of E. coli B/r under anoxia. A cell suspension was ^{60}Co γ-irradiated at 8 kR/min in the studies, and was deoxygenated by bubbling with O_2-free N_2 before and during irradiation. $NaNO_3$ and N_2O were used as electron scavengers. Only non-toxic concentrations of procaine hydrochloride were employed. The mechanism is uncertain, but it is likely that it is related to interaction with the bacterial membranes. Short-lived transients do not appear to play any significant role, and inhibition of post-irradiation repair appears to occur. The ineffectiveness of procaine hydrochloride under oxic conditions needs a satisfactory explanation. (UK)

6869 GENETICS AND SELECTION OF BEAUVERIA BASSIANA (BALS.) VUILL. AN ENTOMOPATHOGENIC FUNGUS. II. Studies of Heterokaryosis. Yurchenko, L. V.; Zakharov, I. A.; Levitin, M. M. (Leningrad Inst. of Nuclear Physics). Genetika; 10: No. 3, 95-101(Mar 1974). (In Russian).

Heterokaryosis of Beauveria bassiana (Bals.) Vuill. an entomopathogenic fungus was discovered by means of plating auxotrophic mutants on a poor medium containing one tenth of the normally required quantities of peptone and yeast extract. Heterokaryotic mycelium could not be formed on this minimal medium, but could grow on it after reinoculation. Various strains of Beauveria have different capacity of heterokaryon formation. In the course of sporulation, heterokaryon segregates into two parental types. Tips of hyphae isolated from young rapidly growing colonies under a binocular microscope proved to be heterokaryotic. Four leucine-dependent mutations were tested for allelism by means of the heterokaryon method. Several prototrophs, apparently diploid, were isolated after uv irradiation of five days old culture of heterokaryons. (auth)

6870 GENETIC ANALYSIS OF UV-INDUCED REVERSIONS IN NORMAL AND RADIOSENSITIVE YEAST HELD IN DIFFERENT POSTIRRADIATION CONDITIONS. Kuznetsova, O. B. (Inst. of Atomic Energy, Moscow). Genetika; 10: No. 3, 85-94(Mar 1974). (In Russian).

The data of the genetic analysis show that more than 70% of reversions towards tryptophan independence ($trp_1 \rightarrow trp^+$) caused in normal yeast by 300 erg/mm² of uv are due to mutation at the suppressor genes. On the contrary, 90% of uv-induced uracyl independent reversions ($ura_1 \rightarrow ura^+$) were the mutations at the ura_1 locus. Postirradiational incubation of yeast in the conditions of intensive DNA synthesis before its plating on selective medium results in the additional fraction of reversions that are mainly of a suppressor type. The incubation of uv-irradiated yeast in the liquid holding recovery conditions decreases the frequency of reverse mutations but does not change the proportion of mutations in locus under study and in suppressor. The mutation of radiosensitivity UVS_3 (rad_4), which presumably blocks excision of dimers is accompanied by the increase in part of suppressor mutations; among the trp^+ reversions the frequency of suppressor reached 100%. The results obtained elevate the question about the specific role of the repair processes in the mutagenesis. (auth)

6871 REACTIONS OF N-ETHYL MALEIMIDE WITH CELLULAR FRACTIONS DURING RADIOSENSITIZATION OF E. COLI B/r. Shenoy, M. A.; Mishra, K. P.; Singh, B. B.; Gopal-Ayengar, A. R. (Bhabha Atomic Research Centre, Bombay). Int. J. Radiat. Biol.; 25: No. 3, 303-311(Mar 1974).

Escherichia coli B/r cells γ-irradiated under anoxic conditions and in the presence of NEM showed enhanced damage in terms of their colony-forming ability. Irradiation led to binding of NEM with cellular macromolecules, particularly proteins. Binding occurred to all amino acid residues. In vitro irradiation of bovine serum albumin in aqueous solution confirmed this. A reaction between NEM and amino acid radical was implicated. The binding of NEM with cellular proteins may lead to inactivation of enzymes involved in post-irradiation biochemical processes giving rise to enhanced damage. NEM also reacts with amino acids in the absence of radiation, which may partly explain the residual sensitization noticed in cells treated with NEM. Part of the sensitizing effect of NEM has been shown to be due to its electron affinic property. (auth)

6872 EFFECT OF GIBBERELLIC ACID AND KINETIN ON IRRADIATED, CHEMICALLY TREATED AND UNTREATED POTATOES. A Possible Method for Identification of Irradiated Tubers. Baraldi, D. (Comitato Nazionale per l'Energia Nucleare, Casaccia, Italy). (1973). vp.

From international colloquium: the identification of irradiated food; Karlsruhe, Ger. (24 Oct 1973).

The action of gibberellic acid and kinetin was investigated in order to detect a possible difference in sprout formation among irradiated, chemically treated and untreated potatoes. Chemically treated and untreated potatoes, under the action of these hormones, produce sprouts within 8 to 10 days, while irradiated potatoes do not. Two local varieties were tested, and the experiments were carried out under different storage conditions. The enhancing effect on the rate of sprouting appears more evident when gibberellic acid and kinetin are used simultaneously. Factors as variety, type and number of chemical treatments, and time of testing play an important role in affecting the rate of sprouting and the sprout length. The possibility of using these substances in order to identify irradiated potatoes is also discussed. (auth)

6873 IRRADIATED KVEIM SUSPENSIONS. Mitchell, D. N. (Medical Research Council, London); Bradstreet, C. M. P.;

Dighero, M. W.; Hinson, K. F. W.; Rees, R. J. W. Lancet; 1: No. 7860, 734(20 Apr 1974).

A study was made of the effect of γ radiation, at conventional sterilization levels, on the cutaneous reactivity of Kviem-test suspensions used in the diagnosis of sarcoidosis. The 10 patients who had tests with irradiated (2.5 mega r) and non-irradiated suspensions showed typical Kviem papules at both test sites. The reactivity of the irradiated suspension showed a marginal advantage. (UK)

6874 EFFECTS OF CAFFEINE ON THE GENETIC MATERIAL. Kihlman, B. A. (Royal Agricultural Coll. of Sweden, Uppsala). Mutat. Res.; 26: No. 2, 53-71(Apr 1974).

From symposium on caffeine as an environmental mutagen and the problem of synergistic effects; Uppsala, Sweden (5 Jun 1973).

The following aspects of the subject are discussed: caffeine metabolism in mammals and the concentrations of caffeine to which we are likely to be exposed; caffeine as an inducer of gene mutations; caffeine as a producer of chromosomal aberrations; and potentiation by caffeine of cell killing, mutations, and chromosome damage induced by ultraviolet light and alkylating agents. The molecular interactions that might be responsible for the effects of caffeine on the genetic material are also discussed. (ERB)

Radiation Effects on Plants

Refer also to abstracts 6896, 6958, 6980, and 7009.

6875 (AEC-tr-7471, pp 105-110) EFFECT OF POSTRADIATION STORAGE OF SEEDS IRRADIATED AT VARIOUS MOISTURE CONTENTS. Fesenko, E. V.; Tsarapkin, L. S. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 407-411(1973).

The moisture content of seeds during their storage after irradiation for no more than three days modifies the radiation effect in the same direction as occurs when its content in the seeds is changed during irradiation: an increase in the moisture content after irradiation is accompanied by a decrease in the radiation damage; with decreasing moisture content, the radiation effect increases. Prolonged postradiation storage of seeds leads to an increase in the final effect, regardless of the conditions of storage. (tr-auth)

6876 (AEC-tr-7471, pp 144-146) ACCELERATION OF ALPHA-AMYLASE SYNTHESIS DURING IRRADIATION OF BARLEY SEEDS AT DOSES INDUCING THE STIMULATION OF DEVELOPMENT. Kuzin, A. M.; Tagi-Zade, Z. A. (Inst. of Biological Physics, Pushchino, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 437-439(1973).

The effects of low doses of irradiation, including doses that stimulate the development of seeds (0.2 to 1 kR) on the synthesis of α-amylase were studied. The results showed that in the region of doses 0.2 to 1 kR, a stimulation of α-amylase synthesis, followed by an inhibition at 5 kR, is observed. It is suggested that one of the starter mechanisms in the radiation stimulation of seeds is radiation acceleration of synthesis of gibberellic acid (the leading growth factor in plants) in the embryos. (tr-auth)

6877 (AEC-tr-7471, pp 155-158) POSTRADIATION INFLUENCE OF AUXIN ON THE FREQUENCY OF STRUCTURAL MUTATIONS IN CREPIS CAPILLARIS CELLS. Slavenas, I. Yu.; Yurgelaitite, K. N. V. (Inst. of General Genetics, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 445-447(1973).

A plant hormone of the auxin type, β-indolylacetic acid (IAA), increases the frequency of chromosome rearrangements in postradiation treatment of Crepis capillaris seeds when added in concentrations of 0.005 and 0.01% and lowers it when 0.001 and 0.015% solutions are used. When the temperature of treatment with IAA and germination of the seeds is lowered from 25 to 7°C, the differences in the frequency of chromosome rearrangements as a function of the IAA to concentration increase. (tr-auth)

6878 (AEC-tr-7471, pp 191-194) PRACTICAL USE OF GAMMA RAYS AND FAST NEUTRONS IN THE TREATMENT OF TOMATO SEEDS. Khafizov, R. N. (Scientific Research Inst. of Vegetable Raising, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 471-474(1973).

The irradiation of tomato seeds with low doses of γ rays (1 to 5 kR) and fast neutrons (0.1 to 0.5 kR) had a stimulating effect on the germination of the seeds and the growth of the roots of the seedlings. The use of high doses of irradiation of tomato seeds (above 20 kR of γ rays and above 2 krad of fast neutrons) for purposes of selection is inadvisable, since in this case the field germination rate is sharply lowered. (tr-auth)

6879 (AEC-tr-7499, pp 80-85) MODIFYING ACTION OF CYSTEINE IN THE CASE OF DAMAGES TO BARLEY CHROMOSOMES BY 200 KeV NEUTRONS. Kartel, N. A.; Troitskii, N. A.; Grushetskii, E. V. (Inst. of Genetics and Cytology, Minsk). 1973. Translated from Radiobiologiya; 13: No. 4, 546-550(1973).

It was shown that cysteine causes the repair of damages to the chromosomes in the rootlets of barley, the seeds of which were treated with cysteine after irradiation with intermediate energy neutrons (200 keV). In a concentration of 0.01 M, cysteine lowered the percentage of chromosome aberrations by more than two-fold. The action of cysteine both in the case of neutron and in the case of x-ray irradiation is exerted chiefly on account of a decrease in chromosome-type aberrations. (tr-auth)

6880 (AEC-tr-7499, pp 158-163) STUDY OF THE MODIFYING EFFECTS OF CAFFEINE AND CHLORAMPHENICOL ON RADIATION DAMAGE TO THE CHROMOSOMES OF VICIA FABA SEEDLINGS. Ganassi, E. E.; Zaichkina, S. I.; Aptikaeva, G. F. (Inst. of Biological Physics, Pushchino, USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 606-610(1973).

As a result of the investigation of the action of caffeine and chloramphenicol on radiation damage to the chromosomes of meristematic cells of V. faba seedlings in different stages of the cell cycle, it was discovered that in the G_2 and S stages both substances produce the same modification of radiation damages in the chromosome. In the G_1 stage, caffeine does not increase the damage, in contrast to chloramphenicol. This permits us to hypothesize a difference in the repair of chromosome damages at different stages of the cell cycle. (tr-auth)

6881 (AEC-tr-7499, pp 195-198) CHANGE IN CHLOROPHYLL AND ITS PROPERTIES IN THE LEAVES OF ROOTING KIDNEY BEAN CUTTINGS, GROWN FROM GAMMA-IRRADIATED SEEDS. Gorianov, N. A. (Gorky State Univ., USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 634-636(1973).

Leaves of kidney bean cuttings, grown from seeds γ-irradiated in doses of 1 and 2 kR, which stimulate root formation, contained more chlorophyll, which possessed better adsorption capacity and more intensive photosynthetic chemiluminescence in comparison with the control. The irradiation of seeds in inhibiting doses of 10 and 12 kR, on the contrary, lowered these indices of chlorophyll in the leaves. (tr-auth)

6882 (AEC-tr-7499, pp 199-202) EFFECTS OF RADIATION ON THE PRODUCTIVITY OF HOP PLANTS, INFECTED WITH CURLYTOP VIRUS. Boiko, A. L.; Sakhno, T. N.; Anokhin, V. M. (Inst. of Microbiology and Virology, Kiev). 1973. Translated from Radiobiologiya; 13: No. 4, 637-639(1973).

Gamma irradiation (100 rad) of hop cuttings infected with curlytop virus promoted a masking of the symptoms of the disease, improved the general condition of the plants and increased the amount of α-acid—the basic component of the bitter substances of hop cones. Irradiation at a dose of 500 rad intensified the symptoms of the disease, disturbed the morphology of the cones and their lupulin grains, and lowered the content of α-acids. (tr-auth)

6883 (AEC-tr-7534, pp 128-132) EFFECTS OF GAMMA IRRADIATION ON THE SEDIMENTATION PROPERTIES OF THE RIBOSOMES. Lyandres, G. T.; Budnitskaya, E. V.; Stoletov, V. N. (Inst. of Biochemistry, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 910-913(1973).

The sedimentation properties of ribosomes isolated from embryos of air-dried wheat seeds and after 24 and 72 h of germination were investigated. The seeds were preliminarily irradiated with γ rays at doses of 5 and 40 kR. The changes in the sedimentation coefficients of the ribosomes isolated at various stages of ontogenesis and under the influence of various doses of radiation were observed. (tr-auth)

6884 (AEC-tr-7534, pp 139-142) MUTAGENIC EFFECTS OF INHIBITORS FROM BARLEY SEEDS IRRADIATED IN PHASES OF ORGANIC AND FORCED DORMANCY. Filippova, N. F. (Inst. of Biological Physics, Pushchino, USSR). May 1974. Translated from Radiobiologiya; 13: No. 6, 918-920(1973).

In the case of joint germination of nonirradiated barley seeds and barley seeds irradiated in two phases of dormancy (organic and forced) in one petri dish, chromosome aberrations are induced in the intact seeds under the influence of mutagens diffusing out of the irradiated seeds. The mutagens from seeds irradiated during organic dormancy induce significantly more chromosome aberrations than mutagens from seeds irradiated during forced dormancy, which can be explained by the complex action of natural and γ ray-induced mutagens. (tr-auth)

6885 INDUCTION OF CHANGES IN THE FLOWERING TIME OF RICE AFTER X-RAY AND ^{32}P TREATMENT. Majumder, B. Trans. Bose Res. Inst. (Calcutta); 35: No. 2, 31-35(Jun 1972).

Four varieties of rice namely Dular, Marichbati, Jhanjee, and Satika were treated with different doses of x rays (25 kR, 50 kR, 75 kR) and ^{32}P (5 μCi, 10 μCi, 15 μCi, 20 μCi, and 30 μCi). In the treated generations (X_1 and P_1) of rice changed variabilities in the flowering time, mean time of flowering, were observed. (auth)

6886 INFLUENCE OF BIOLOGICAL CRITERIA ON THE MAGNITUDE OF DAMAGE INDUCED BY GAMMA-RAYS AND GAMMA-IRRADIATED MEDIUM. Kesavan, P. C.; Swaminathan, M. S. (Jawaharlal Nehru Univ., Delhi). Indian J. Exp. Biol.; 11: No. 5, 382-385(Sep 1973).

The magnitude of specific biological effects arising from the exposure of normal test systems directly to gamma rays or to irradiated sugar-containing medium was compared. The extent of a specific biological effect induced by toxic principles present in the irradiated sugar was much smaller in strict comparison with that produced by direct exposure of the biological system to radiation at a given dose, and that it varied with the test system and also the criterion (physiological, cytological, or genetical) chosen for the assessment. Thus, the cytotoxic potency of irradiated culture media to inhibit pollen tube growth in Tropaeolum majus was of the order of 1020×10^{-4}, the radiomimetic potency to cause chromosome aberrations and micronuclei in Vicia faba was 4.4×10^{-4}, and its mutagenic potency to induce autosomal (II-chromosome) recessive lethal mutations in Drosophila melanogaster was of a much lower order of 1.5×10^{-4} in strict comparison with the respective biological effects induced through the exposure of the test systems directly to gamma-irradiation. These results were interpreted on the basis of certain basic differences between the pathways of biological action initiated in the organisms exposed directly to gamma rays and media containing gamma-irradiated sugar. (auth)

6887 NATURE OF THE ALBINO MUTATION OF COTTON OBTAINED BY THE IRRADIATION OF POLLEN. Mukhamedzhanova, D.; Egamberdiev, A.; Semenikhina, L. V.; Abdullaev, T. (Inst. for the Experimental Biology of Plants, Tashkent). Uzb. Biol. Zh.; No. 1, 50-52(1974). (In Russian).

The appearance of albino mutations in cotton of the C-4727 and 108-F varieties in the M_1 and M_2 generation as a result of the irradiation of pollen with γ rays at doses of 0.5, 1.0, and 3.0 kR is described. Complete albino mutations disappear in the phase of two cotyledon leaflets; albino mosaics survive and bear fruit. During self-pollination of the mosaics green, mosaic, and albino plants appear in the ratio 1 : 2 : 1. Albino mutations in cotton appear as a result of γ radiation in the kernel of generative pollen cells and are recessive. Complete albino, homozygous albino mutations and mosaics appear with green heterozygotes. In this mutation the albino parts appear as a result of somatic crossing over. (tr-auth)

6888 SOMATIC MUTATIONS INDUCED IN STAMEN HAIRS OF TRADESCANTIA CLONE 02 BY RELATIVISTIC MUONS. McNulty, P. J.; Sparrow, A. H.; Schairer, L. A. (Brookhaven National Lab., Upton, NY). Int. J. Radiat. Biol.; 25: No. 3, 315-320(Mar 1974).

The dose and dose-rate response of muon-induced blue-to-pink somatic mutations in the stamen hair cells of Tradescantia clone 02 were studied. It was found that the relative biological effectiveness of 6 ± 2 GeV/c μ^+ relative to ^{137}Cs gamma rays was significantly less than at dose rates of 0.8 to 1.0 rads/hour. At this dose rate there was no inclination of a dependence of rbe on dose for the range of doses (5 to 32 rads) studied. (UK)

6889 COMPARATIVE STUDY OF THE EFFECTS OF SINGLE AND TERNARY γ IRRADIATION ON CHANGEABILITY OF PHASEOLUS VULGARIS. Batikyan, G. G.; Egiazaryan, J. S. (Erevan State Univ.). Biol. Zh. Arm.; 26: No. 12, 17-23(Dec 1973). (In Russian).

The effect of single and ternary γ irradiation (^{60}Co) at doses of 5, 8, and 10 kR on the changeability of Phaseolus was studied. A comparison of the frequency and spectra of induced mutations and the study of the mutants in M_2 to M_4 generations showed differences in the efficiency of these radiation doses. (tr-auth)

6890 EXPERIMENTAL FINDINGS CONCERNING THE EFFECT OF PROTON AND GAMMA IRRADIATION ON FOODS. Bychkov, V. P.; Kozar, M. I.; Popov, V. I.; Boiko, N. N.; Kolchin, E. V.; Khokhlova, O. S.; Yurgov, V. V. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 6-10(1974). (In Russian).

Experimental findings are presented on the effect of proton and gamma irradiation at a dose of 1.5 and 7.0×10^4 rads on sunflower oil, vitamin concentrates, dry milk and dry brewers' yeast. Results of studying the amino acid composition, vitamin content, and decomposition of these products with pancreatine and lipase in vitro are given. The irradiation of these products decreased the content of vitamins and decomposition of sunflower oil with lipase, and deterioration of organoleptic properties of irradiated milk during storage. (auth)

6891 ACTION SPECTRUM FOR ENZYMATIC PHOTOREACTIVATION IN MAIZE. Ikenaga, M.; Mendo, S.; Fujii, T. (Osaka Univ.). Photochem. Photobiol.; 19: No. 2, 109-113(Feb 1974).

An ammonium-sulfate-precipitable (35 to 70%) fraction in extracts of Zea mays pollen contained photoreactivating enzyme that reactivated the transforming ability of ultraviolet-inactivated Hemophilus influenzae DNA. The action spectrum of in vitro photoreactivation with the enzyme had a broad single maximum at 385 nm. Parallel to the in vitro response, in vivo photoreactivation of ultraviolet-induced premutational damage in pollen of this plant was more efficient at 405 nm than at 334 nm. From these results it was concluded that photoreactivation of ultraviolet-induced mutational damage in maize pollen was chiefly of the direct enzymatic type. (auth)

6892 COMPARISON OF THE EFFECTS OF IONIZING IRRADIATION ON THE ELECTRICAL PARAMETERS IN NITELLA WITH THE EFFECTS OF VISIBLE LIGHT. Hansen, U. P.; Keunecke, P. (Univ., Kiel). Atomkernenergie; 23: No. 1, 5-8 (1974).

Experiments are reported that demonstrate that the same effects that are supposed to mediate the reversible responses of membrane potential and resistance in Nitella to ionizing irradiation also are involved in the action of light on these parameters: the enhancement of passive permeability, which is found at high light intensities, and slowing down an electrogenic pump, which is observed at low light intensities. The main means of these investigations is the comparison of the effects on potential and resistance. Some pecularities regarding the measurement of resistance are pointed out. (auth)

6893 INFLUENCE OF IRRADIATION ON THE LIGHT EFFECT IN NITELLA. Keunecke, P. (Univ., Kiel). Atomkernenergie; 23: No. 1, 9-11(1974).

Internodal cells of Nitella mucronata were illuminated periodically by 1.5 min light and 1 min dark and the light induced change of membrane potential before, during, and after irradiation was measured. 20 min after an irradiation dose of 24 kR, the magnitude of the light induced change of membrane potential is not markedly influenced, whereas 20 min after a dose of 360 kR it vanishes nearly completely. Five to eight min after the application of a dose of 24 kR there is a rapid decrease of the light effect slowing down to about 20% of the initial value. After about 15 min it reaches a slight maximum. It is assumed that this decrease is due to a slowing down of the activity of the electrogenic proton pump by irradiation. (auth)

6894 UNSTABLE MUTANTS OF BRONZE INDUCED BY PRE-MEIOTIC X-RAY TREATMENT IN MAIZE. Mottinger, J. P. (Univ. of Rhode Island, Kingston). Theor. Appl. Genet.; 43: No. 3/4, 190-195(1973).

A study was made of the effects of pre-meiotic x irradiation on the bronze locus in chromosome 9 of maize. Plants of Sh Bz Wx/Sh Bz Wx constitution were treated with ca. 1000 R and pollen from these individuals was applied to silks of sh bz wx tester plants. In the F_1 progeny, three Sh Wx kernels having a bz aleurone or showing Bz-bz variegation (the bz-x_3, bz-x_4, and bz-x_5 mutants) were selected as possible mutations at the bz locus. One kernel of sh bz wx phenotype as well as one exhibiting sh, bz, and Wx (sh-bz-x_3) were also selected for more intensive study. Progeny tests of the sh bz wx individual along with cytological observations indicated that a ring chromosome was the probable cause of the mutant phenotype although an alternative hypothesis is not ruled out. The behavior of sh-bz-x_3 can be interpreted as the result of either a minute deficiency involving the Sh and Bz loci or a simultaneous suppression of the two dominant alleles. Progeny of the bz-x mutants exhibited genetic instability of bronze. It is hypothesized that this behavior is due to the activation or alteration by x rays of gene control mechanisms that affect the bronze gene. (auth)

6895 EFFECT OF GAMMA RADIATION ON THE STORAGE OF ONIONS USED IN THE DEHYDRATION INDUSTRY. Salem, S. A. (National Research Center, Cairo). J. Sci. Food Agr.; 25: No. 3, 257-262(Mar 1974).

Gamma radiation (8000 rad) of fresh onion bulbs, used in the dehydration industry in Egypt, was investigated. Irradiation reduced sprouting of the fresh bulbs, but did not affect the rotting of the bulbs. No effects on sugar content or color (optical density at 330 nm) of the fresh bulbs and dried onion flakes were observed.

The irradiated onion had a noticeably lower ascorbic acid content, pungency (measured as volatile reducing substances) and free amino nitrogen content in comparison with non-irradiated bulbs. Darkening of onion flakes during storage for 8 weeks at 40°C did not differ when the bulbs were treated with gamma rays before dehydration. (auth)

Radiation Effects on Animals

6896 AMERICAN SOCIETY FOR PHOTOBIOLOGY FIRST ANNUAL MEETING, SARASOTA, FLORIDA, JUNE 10–14, 1973. Washington, DC; American Society for Photobiology (1973). 189p. (CONF-730655-(Absts.)). $12.25.

Man

Refer also to abstracts 6478, 6485, 6489–6491, 6498, 6507, 6508, 6539, 7470, 8561, and 8565.

6897 (CONF-700681–, pp 103-104) PHYSIOLOGICAL EFFECTS OF AMBRATIN IN HEALTHY MEN. Efimov, V. I.; Kravchuk, L. A.; Suslova, L. N.; Maslov, I. A.; Anan'ev, G. V.; Kuz'min, M. P.; Filatova, L. M.; Reutova, M. B.; Tsyganova, N. I. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Ambratin is a complex preparation containing 0.2 g of mercamine bitartrate and 0.0005 g of pyridoxin in a single tablet. The clinico-physiological testing of ambratin was performed on healthy men aged 25 to 40. Two doses of ambratin (0.6 g each) with one hour intervals between doses and a total dosage of 1.2 g (for cysteamine) was withstood satisfactorily by healthy individuals. No pathological conditions of any sort involving the internal organs were found following the taking of ambratin. In the case of increased individual sensitivity to ambratin, which was observed in five subjects out of ten, there may be vertigo, a sensation of heaviness in the head, a brief condition of stress or, on the other hand, weakness, fatigue (more rarely), lasting from thirty minutes to three hours following the taking of the preparation. This is accompanied by functional changes in the vestibulo-cerebellar system, a slight increase in the vestibulo-vegetative sensitivity with normalization of these disruptions after twenty-four hours. No disturbances were observed after twenty-four hours had elapsed. No pathological changes occurred in the qualitative and quantitative composition of the peripheral blood after taking ambratin. (ERB)

6898 (CONF-700681–, pp 105-106) PHARMACOLOGICAL PROPERTIES AND TOLERANCE OF MAMMALS TO THE RADIOPROTECTOR CYSTAMINE HYDROBROMIDE. Saksonov, P. P.; Volkov, M. N.; Dobrov, N. N.; Kozlov, V. A.; Chernyakova, T. A.; Chernenko, G. T. 1970. Translated from Materials of the first all union conference, pharmacology of antiradiation preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Experiments on different species of animals demonstrated that as far as radioprotective properties of the salts of cystamine are concerned (chlorhydrate and hydrobromide), they are practically the same, except that cystamine hydrobromide has been found to have a considerable latitude of therapeutic action. (This substance is often referred to as finam.) In terms of its general effect, finam was found to be 1.4 times less toxic than cystamine chlorhydrate. The results of these studies indicate that the oral administration of finam at doses of 600 mg does not cause significant changes in the general condition and working ability of healthy individuals. Finam was satisfactorily tolerated by patients and exerts a favorable influence on the initial postradiational reaction during the course of x-ray therapy. (ERB)

6899 (CONF-700681–, pp 111-113) CARDIOVASCULAR EFFECTS FROM THE INTRAVENOUS ADMINISTRATION OF SEROTONIN IN MAN AND THE RATE OF ITS EXCRETION. Dreshvyannikov, B. B.; Pochukaeva, L. I.; Kharitonov, V. V.; Shorokhov, A. I. 1970. Translated from Materials of the first all union conference, pharmacology of antiradiation preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Serotonin was given intravenously at the rate of 0.15-1.4 mg/min (on the basis of 0107-0.62 mg/min). From five to 40 mg of serotonin were dissolved in 100 ml of physiological solution. The solution administered contained 0.4 to 0.05 mg/ml of serotonin, i.e., it exceeded its natural content in the blood by 1,000 to 10,000 times. Immediately after administration, the concentration of serotonin in the blood increased two to five times in comparison with the initial value. The determination of 5-OIAA in the urine, performed according to the method of Udenfrid et al., showed that during the first two and a half hours after the start of injection, the organism excreted 50 to 72% of the administered serotonin, and 77 to 100% of it in twenty-four hours. An increase was found in the systolic and minute volumes of the heart, the frequency of the rhythm of cardiac contractions, and an increase in the maximum arterial pressure. Peripheral resistance and volume pulse were reduced. In addition to the drop in peripheral resistance, cases of a pronounced increase in the tonus of the peripheral small arteries and arterioles, indicated by a drop in the amplitude of the digital volume pulse during the first three to fifteen minutes after the start of the injection of serotonin, were observed. (ERB)

6900 (COO-3017-12) PATHOLOGIC CRITERIA OF RADIATION INJURY. Warren, S. (New England Deaconess Hospital, Boston, Mass. (USA). Cancer Research Inst.). 1974. 15p. (CONF-740224-1). Dep. NTIS $4.00.

From 26th annual meeting of the American Academy of Forensic Sciences; Dallas, Texas, USA (14 Feb 1974).

Radiation should be suspected as a cause of death of man on the basis of appropriate history and for one of the following gross anatomic findings: chronic obstructive ulcers of the gastrointestinal tract, chronic ulcers of the skin, epilation, unexplained bone or cartilage necrosis, unexplained anemia, leukopenia, purpura, or marrow atrophy. Histologic criteria for radiation injury are vascular damage, telangiectatic or occlusive; hyalinization of collagen; atrophy of cells with fibrosis; presence of giant cells with large nuclei; and the presence of chromosomal aberrations. (auth)

6901 (JAERI-M-5370) HEALTH PHYSICS AND SAFETY IN JAERI, NO. 15. (Japan Atomic Energy Research Inst., Tokyo). Sep 1973. 240p. (In Japanese). NTIS (U. S. Sales Only).

In the annual report No. 15 (fiscal 1972), the activities of health physics and safety in the Tokyo Office, Tokai Research Establishment, Takasaki Radiation Chemistry Research Establishment, and Oarai Research Establishment are described. (auth)

6902 (NIRS-12) ANNUAL REPORT OF THE NATIONAL INSTITUTE OF RADIOLOGICAL SCIENCES FOR THE FISCAL YEAR 1972. (National Inst. of Radiological Sciences, Chiba (Japan)). Sep 1973. 75p. NTIS (U. S. Sales Only).

Research activities of the National Institute of Radiological Sciences for the period of April 1972 to March 1973 are presented in the form of brief individual reports. Chapters are: physics and chemistry, biochemistry and biophysics, cytology and morphology, physiology, genetics, medical studies, and environmental studies. (JA)

6903 (NIRS-AR-15) ANNUAL REPORT OF THE NATIONAL INSTITUTE OF RADIOLOGICAL SCIENCES FOR THE FISCAL YEAR 1972. (National Inst. of Radiological Sciences, Chiba (Japan)). Sep 1973. 136p. (In Japanese). NTIS (U. S. Sales Only).

Activities of the NIRS for the period of April 1972 to March 1973 are reported in the form of individual short summaries. As features of the year, in addition to the special subjects in the past years, the transplantation of hematopoietic tissues and the neutron-ray utilization in medicine, specific works, i.e., the introduction of medium-sized laboratory animals and the biochemical research of urine etc. in irradiated persons, were started. In the meantime, construction of a medical cyclotron proceeds satisfactorily, and the therapeutical usage of a linear accelerator was further advanced. Divisions of the NIRS include the following: physics, chemistry, biology, genetics, physiology and pathology, radiation hazards, pharmaceutical science, environmental hygiene, environmental contamination, clinical research, radiation health, marine radiological research, personnel training, and hospital. (JA)

6904 (NP-19987) NINTH REPORT FROM NORSK HYDRO'S INSTITUTE FOR CANCER RESEARCH FOR 1971 AND 1972. (Norsk Hydros Institutt for Kreftforskning, Oslo). 1973. 94p. Dep. NTIS (US Sales Only) $7.75.

Research programs on mechanisms for carcinogenesis and the chemical sensitization of neoplastic cells to the action of ionizing radiation are summarized. (CH)

6905 (PB-227840) REVIEW OF DETERMINATIONS OF RADIATION DOSE TO THE ACTIVE BONE MARROW FROM DIAGNOSTIC X-RAY EXAMINATIONS. Shleien, B. (Bureau

of Radiological Health, Rockville, Md. (USA)). Oct 1973. 21p. (FDA-74-8007).

This review illustrates in detail the steps required for the determination of the mean active bone marrow dose from diagnostic x rays, and the procedures employed by investigators in making such determinations. In addition, a comparison is made of the results thus far obtained from all available studies. The purpose of this review of the literature is to provide background for planning additional determinations of active bone marrow doses. (auth)

6906 METHODS OF MOBILE IRRADIATION OF BRAIN TUMORS. Lokshina, A. M.; Lyutova, N. A. Med. Radiol.; 19: No. 5, 54-58(May 1974). (In Russian).

The main features of mobile γ-therapy of brain tumors of different localization were considered. They defined: neoformations of the large cerebral hemispheres, neoformations of the median structures, and neoformations of posterior cranial fossa. The application of mobile methods of irradiation makes it possible to adjust the geometry of a 80% isodose surface to that of the brain tumors and to reduce considerably the loading on the critical organs and vitally important structures of the brain. (auth)

6907 NEW TRACERS FOR NUCLEAR MEDICINE. Bernard, P.; de Laforte, C.; Brian, C. (Univ., Marseille). pp 281-283 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The development of new very pure γ emitter radionuclides of very short half-life enables a large reduction to be achieved in the irradiation of organs explored by scintiscanning techniques. In addition, the high nuclide activities that can be injected into the patient permit dynamic recordings to be made of morphological phenomena; stationary Auger type γ camera detectors are used for the measurements. The administration of high levels of activity, nevertheless, necessitates special precautions to be taken by the personnel of the nuclear medicine services concerned. The doses received by different organs and by the gonads are given and compared to those due to classical tracers. Some of the results obtained with ^{99m}Tc, ^{87m}Sr and ^{113m}In are exposed, particularly in the field of moving film gammagraphy. (FR)

6908 POPULATION MEAN MARROW DOSE AND LEUKEMIA SIGNIFICANT DOSE FROM BEAM-THERAPY IN JAPAN, 1971. Hashizume, T.; Kato, Y.; Kumemoto, Y.; Kawachi, K.; Nishizawa, K.; Yamaguchi, H. (National Inst. of Radiobiological Sciences, Chiba, Japan). Health Phys.; 26: No. 5, 461-467(May 1974).

The 1971 population mean marrow dose and leukemia significant dose from beam-therapy in Japan were estimated. The estimation was made on the basis of a nation wide survey. The leukemia significant dose was calculated by adopting a weighting factor, which takes account of the shape of the time-incidence curve of radiation-induced leukemia at Hiroshima due to A-bomb, and the survival statistics for the various age groups in the population. The population mean marrow dose was 45 and 161 mrad/person/yr for males and females, respectively, with a total of 206 mrad/person/yr. The leukemia significant dose was 7 and 30 mrad/person/yr for males and females, respectively, with a total of 37 mrad/person/yr. (auth)

6909 INFANT AND NEONATAL MORTALITY RATES DURING PRE- AND POST-REACTOR PERIODS FOR GEOGRAPHIC AREAS ADJACENT TO SHIPPINGPORT, PENNSYLVANIA. Gerende, L. J.; Taylor, F. H.; Sumpter, E. H.; Schwarzbach, R. H.; Rogers, K. D. (Univ. of Pittsburgh). Health Phys.; 26: No. 5, 431-438(May 1974).

Temporal trends in infant and neonatal mortality rates for populations residing in geographic areas surrounding the nuclear reactor at Shippingport, Pennsylvania are examined during the pre- and post-operational periods of the reactor. This examination, utilizing regression analysis, is a search for statistical evidence to support various hypotheses concerning the relationship of these trends to operation of the reactor. The results do not justify rejection of the statistical hypothesis that temporal trends were similar in the pre- and post-reactor periods. (auth)

6910 DOSIMETRIC PLANNING OF SHORT DISTANCE ROENTGEN THERAPY. Frolova, A. V. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 19: No. 4, 77-80(Apr 1974). (In Russian).

The obtaining of the dosimetric data, necessary for planning radiation therapy involves the use of different methods and demands a great number of measurements. A method of simultaneously obtaining data on the dose distribution and quantitative content of irradiation in the irradiation field with the help of a fluid ionizing chamber is suggested. (auth)

6911 HOW SAFE IS AN ENERGY SUPPLY SYSTEM BASED ON NUCLEAR ENERGY? What is Safe Enough, Who Decides What Safe Enough Is? Tekle, J. (Trondheim Univ., Norway). Tek. Ukebl.; 121: No. 14, 50-53(28 Mar 1974). (In Norwegian).

The author questions several statements made by Lingjaerde in an article in Tek. Ukebl. No. 5, 1974, regarding the safety of nuclear power plants and the reliability of emergency core cooling systems. He cannot accept the claim that nuclear power has a 100% accident free record or that the plutonium released to the atmosphere in nuclear weapon tests has not led to detectable injuries. Neither is the probability that an ECCS will function in the event of an accident found to be acceptable. Finally it is stated that the problems in storing radioactive waste are of such a nature as to be insoluble. (NO)

6912 RADIOLOGY NOW: THE 10 DAY RULE. Burch, P. R. J.; Warrick, C. K.; Day, R. (Leeds General Infirmary, Eng.). Brit. J. Radiol.; 47: No. 555, 198-199(Mar 1974).

Comment is made in three letters on a previous editorial concerning the application of the 10-day rule in obstetric radiography, (B. J. Radiol., (Nov 1973)). The need is stressed for a balanced review of literature when assessing hazards. Responsibility for implementation of the rule is discussed in relation to staff in hospital departments. (UK)

6913 RADIOLOGICAL EXPLORATION OF THE LUNG IN INDUSTRIAL MEDICINE. Comparative Studies of Different Systems. Fecci, R.; Juilien, G.; Buxerolle, M.; Kurkdjian, J.; Lamotte, A. H. (CEN de Cadarache, Saint-Paul-les-Durance, France). pp 331-336 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

Article 13 of the decree of the 13 January 1969 on the organization of Industrial Medicine Services states that all personnel should be subjected to a medical examination before they become employed by enterprise, or at the latest, before the expiry of their probationary period prior to their integration into the enterprise. The examination involves radiological examination of the lungs. In addition to its responsibility for new personnel, the Industrial Medicine Service is also responsible for surveying workers exposed to pneumoconiosis risks. Annual radiological examinations are performed in view of detecting tuberculosis. The purpose of the work undertaken was to investigate the different radiological techniques used for lung examinations in order to determine which is the most suitable for Industrial Medicine applications. The following techniques were studied successively: radioscopy, radiography, and radiophotographic pulmonary examinations. The advantages and disadvantages of each technique are discussed. The Radiological Protection Service, CEN, CADARACHE conducted measurements on the doses received by individuals being examined and the persons carrying out the examinations. Calculations were also made on the percentage of the personnel examined by the Industrial Medicine Service Association for the Building and Public Works Industries of Bouches-du-Rhone. Dose exposure measurements were effected in the beam using the VICTOREEN 605A chamber (window thickness 7 mg cm^{-2}) in conjunction with the RADOCON 575 reader. The integration measurements were made using a VICTOREEN 605 chamber matched to the NARDEUX QDCI charge quantizer. The VICTOREEN 605 chamber possesses a thick (405 mg cm^{-2}) air-equivalent wall. The chamber was calibrated by comparing it with the VICTOREEN 605A chamber, the same beam characteristics (kv) being used in the two cases. Scattered radiation measurements were made with the VICTOREEN 208A and 239A (window thickness 1 mg cm^{-2}) chambers as well as with the VICTOREEN 754 pocket dosimeters (7 mg cm^{-2} mylar over 50% of the surface used in conjunction with the VICTOREEN-MINOMETER reader-charger. (FR)

6914 PROFESSIONAL RADIODERMATITIS OF THE HANDS. Lagrot, F. pp 321-330 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The development of lesions is presented from the moment of their appearance up until ulceration and cancers, a twelve year period being considered. The degenerating of lesions into cancers occurred in 59 out of 109 of the cases studied i.e., 55% of the cases. Only surgical treatment is possible. The techniques

used are exposed: ablation of the damaged skin from the fingers and its replacement with a graft of skin obtained in the form of a very thin flap taken from the forearm with a razor-plane. The graft is successful in 100% of the cases and allows the fingers to move normally. The patient can always go back to his original job or profession. Even when the lesions have degenerated treatment can nearly always be carried out to preserve the patient's fingers. It is only in rare cases when the deep lying planes are cancerous that the finger must be amputated. It is emphasized that the hands should never be exposed to radiation and that the repetition and accumulation of radiations lead to radiodermatitis, which is only curable by surgery (mostly economic and permanent). The operation is simple and the results obtained excellent even in the cases where the lesions have become cancerous. (FR)

6915 COMPLEX GEOMETRY FIELD DOSIMETRY IN COBALT THERAPY. Vrousos; Guilmard, R. (Centre Hospitalier Regional, Grenoble, France). pp 347-354 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The irradiation of large volume targets for the treatment of hematosarcomas, and, in particular Hodgkin's disease, leads to dosimetry problems as a result of the complex geometry of the irradiation field. Theoretical aspects of the problem are reviewed. Work already conducted in this domain is examined and experimental results obtained from direct measurements made with phantoms (photographic and thermoluminescence measurements) are presented. The results are compared with those obtained by calculations. (FR)

6916 RADIOPROTECTION AND THE USE OF LARGE DOSES IN NUCLEAR DIAGNOSIS. Vigne, J. P. (Centre Regional de Lutte Contre le Cancer, Marseille). pp 285-290 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

Intermediate half-life mixed β and γ emitters were used up until the end of the last decade; these emitters only resulted in the β irradiation of the patient and involved little risk for the personnel. The recent introduction of the Auger camera and the commercial availability of short half-life relatively pure γ emitters has completely modified the situation. The integrated dose absorbed by the patient has been considerably reduced. The γ radiation utilized is only very slightly absorbed by the tissues. In consequence, the dose administered can be much higher than those previously possible. In certain radiocardiography measurements, as much as 100 mCi can be used in an examination, the integrated dose, nevertheless remaining extremely small. However, the doctors concerned now face the problem of injecting activities that exceed by a factor of 1000 those they are used to handling. The patient must be considered as a nonnegligible radiation source. Protective measures for this purpose are either nonexistent or makeshift. Further developments in radioprotection techniques are required for the clinical laboratories concerned together with the availability of adequate materials: shielded control parts, television camera control, injection materials, and remote controlled tables. The use of radioactive xenon for lung ventilation and circulation studies is presented as an example. (FR)

6917 THERAPEUTIC APPLICATIONS OF RADIOISOTOPES. Results Obtained up to the Present Day. Gary-Bobo, J. (Centre Regional de Lutte Contre le Cancer, Marseille). pp 291-297 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

Since their introduction into medicine both good and bad results have been obtained with radioisotopes. The results obtained up to the present day are presented together with the different ways in which radioisotopes are used: external use, i.e., contact and remote radiotherapy (^{32}P, ^{90}Sr, ^{144}Ce, and ^{106}Ru were once commonly used in contact radiotherapy but have since been superseded by electron accelerator and other radiotherapy techniques: ^{60}Co and ^{137}Cs are extensively used nowadays, their widespread applications resulting from their ease of use and the good results obtained); interstitial use (permanent implants of radium, ^{198}Au, ^{90}Y, and ^{32}P were once popular, such techniques have been superseded by surgery or external radiotherapy as a result of the technical difficulties and radioactivity hazards involved; temporary implants are still, however, used in radiotherapy; although radium has lost popularity because of the radioactivity hazards it presents and handling difficulties, there are still enthusiasts who advocate its use; on the other hand ^{192}Ir is finding an increased use because of the protection facilities available and after-loading techniques); intra-cavity use (after a good start this type of treatment produced disappointing results because of the technical difficulties occurring and the radiation dangers to which both the operator and patient are exposed; only ^{32}P and ^{90}Y are still used for serous cavities, and even in this case chemical therapy offers an alternative method); internal administration (in particular cases, this method provides very good results: ^{131}I for hyperthyroidism, ^{32}P for Vaquez's disease); nevertheless in all other cases either external radioisotope therapy or chemical therapy are favored. This preference is due, in particular, to the difficulties experienced in using radioisotopes, i.e., the necessity of having a specialized service, the radioactivity hazards involved and also to the rapid developments that have been made in chemical therapy and external radiotherapy). (FR)

6918 RADIOLOGICAL SIGNIFICANCE OF X-RAY LEAKAGE FROM ELECTRON MICROSCOPES. Parsons, D. F.; Phillips, V. A.; Lally, J. S. (Roswell Park Memorial Inst., Buffalo). Health Phys.; 26: No. 5, 439-448 (May 1974).

The question of whether electron microscope users were being subjected to a significant x-ray hazard was probed in several ways. A questionnaire was sent out to the Electron Microscopy Society of America membership to determine the hours of use of microscopes, the measured x-ray leakages and the average and maximum x-ray exposure for electron microscopists. It appears that only a few, if any, out of several thousand long term electron microscope users, could have received an x-ray exposure detrimental to their health. However, sufficient number of design errors, user misuse, and accidental x-ray exposures have been recorded to make early national and international agreement on x-ray leakage level and x-ray leakage monitoring standards desirable. A survey of the death certificates of deceased EMSA members did not show a significant increase of any cause of death among electron microscopists. The U. S. Federal and EURATOM standards for leakage from electronic equipment are similar, and it is suggested that international safety standards based on these should be adopted in the near future. (auth)

6919 CONTENT OF PYRUVATE AND LACTATE IN THE BLOOD OF PATIENTS IN COMBINED TREATMENT OF CANCER OF THE LUNG, ESOPHAGUS, OR STOMACH. Kubareva, M. M.; Pokas, L. V.; Kiselev, S. O. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 19: No. 4, 52-57 (Apr 1974). (In Russian).

The increase of the content of pyruvate and lactate in the blood in comparison with the results obtained before irradiation was not observed in patients with cancer of the esophagus and stomach who had undergone preoperative irradiation on betatron with the energy of 25 MeV with cumulative dose in the focus of 3000 to 3500 rad up to the moment of operation (2 to 3 weeks after the end of radiation therapy). The decrease of the content of pyruvate and lactate was observed in cancer of the lung in case of positive clinico-roentgenological dynamics after a preoperative irradiation, apparently, as a result of improvement in gaseous exchange. The study of the level of lactacidemia in a postoperative period did not reveal the negative influence of a preoperative irradiation on the condition of oxidation processes. A rise in the content of pyruvate and lactate in the blood of the patients was caused, mainly, by the scope of surgical intervention. (auth)

6920 PULMONARY COMPLICATIONS IN POSTOPERATIVE γ THERAPY IN PATIENTS WITH CANCER OF THE LUNG. Skrzhinskaya, I. Ch.; Savitskaya, A. A. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 19: No. 4, 46-52 (Apr 1974). (In Russian).

Results are presented of roentgenological observations made on 122 patients with cancer of the lung after combined treatment: radical or palliative operations and subsequent telegammatherapy. Radiation pneumonites were observed in 34 patients and 16 patients had the severest course of the disease which led in the end of 3 of them to the development of bronchial fistula. Frequency, localization, scope and course of the radiation reaction in the pulmonary tissue were closely related with the conditions of radiation treatment. (auth)

6921 EXTERNAL RESPIRATION IN PATIENTS WITH CANCER OF THE LUNG IN PREOPERATIVE IRRADIATION ON BETATRON 25 MeV. Pronin, V. I.; Pokas, L. V.; Fonin, V. E. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 19: No. 4, 41-45 (Apr 1974). (In Russian).

No improvement of indices of pulmonary ventilation was observed even with obvious reduction of the size of the tumor in

patients with peripheral cancer of the lung who had undergone a preoperative course of radiation therapy using 25-MeV electrons with cumulative focal dose of 2500 to 4000 rad. The reduction of the reserve respiration was always observed in the absence of changes or in cases when small changes of the tumoral process developed after the operation. The improvement of the function of external respiration occurred mainly in patients with central cancer in whom owing to irradiation reduction of the tumor and restoration of the respiratory surface of the lung at the expense of flattening of atelectasis was observed. (auth)

6922 INFLUENCE OF DIFFERENT CONDITIONS OR IRRADIATION ON THE EXTERNAL RESPIRATION FUNCTION IN PATIENTS SUFFERING FROM CANCER OF THE LUNG AFTER RADIATION OR COMBINED TREATMENT. Syromyatnikova, E. N. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 19: No. 4, 37-41(Apr 1974). (In Russian).

The character of changes of the function of external respiration depended on the conditions of irradiation, especially on the size of a single dose with daily irradiation of the patients who had undergone a postoperative course of radiation therapy. During irradiation with comparatively small single doses (210 ± 8,1 rad) functional condition of the lungs improved, apparently due to the restorative processes that developed after the operation. Functional capacity of the external respiration apparatus was reduced in cases when doses of 250 ± 9.4 rad were applied. (auth)

6923 APPLICATION OF COMPUTERS IN RADIATION THERAPY. Krongauz, A. N.; Golovan, V. A. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 19: No. 4, 31-36(Apr 1974). (In Russian).

Experience in application of universal computers and development of specialized analogo-calculating machines shows the expediency of their application for calculation of dose distributions and optimization of conditions of irradiation in radiation therapy. Both types of computers have their own merits and defects in solving the problems of clinical dosimetry. Universal computers can be effectively used at special computer centres. Analogo-calculating machines should be included into the set of irradiation units and ensure the whole cycle of radiation therapy, beginning from obtaining information about the patient and ending by an automatic control of the irradiation unit. (auth)

6924 PREOPERATIVE IRRADIATION IN OPERABLE CANCER OF THE RECTUM. Kozlova, A. V.; Brusilovskii, M. I.; Tarasova, G. V.; Grigoryan, V. S.; Popova, T. V. Med. Radiol.; 19: No. 4, 12-18(Apr 1974). (In Russian).

A comparative study was made of the patients' condition, technical conditions for carrying out the operation, and the course of postoperative period in patients with preoperative radiation therapy made by the method of macrofractionation with focal doses of 2000, 4000, and 6000 rad. In the irradiation period in some patients torpidity, bad appetite, nausea, and sometimes leucopenia were observed. All these phenomena were developing with the increase of the dose, but they were not easily reversible in all the cases. With the dose of 2000 rad the operation can be performed during 2 to 3 days after the course of radiation therapy but with greater doses the operation is to be postposed because of the development of radiation reactions. Conducting operative intervention after radiation therapy the authors noted a hemorrhagic diathesis of the tissues, which rose in parallel with the dose increase, and some technical complications due to fibrous changes with high doses, but these complications can be overcome. (auth)

6925 POSSIBILITIES AND PERSPECTIVES OF DEVELOPMENT OF RADIATION THERAPY OF TUMORS OF THE ORGANS OF THE GASTRO-INTESTINAL TRACT. Pereslegin, I. A.; Sarkisyan, Yu. Kh. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 19: No. 4, 7-12(Apr 1974). (In Russian).

Methodological problems, the use of which will increase the effect of radiation therapy of malignant tumors of the organs of the gastrointestinal tract, are discussed. Special attention is paid to the use of appliances collimating a beam of ionizing radiation (lead grid filters, wedges, blocks), to the wide use of the mobile beam, particularly of rotation gamma-therapy with controlled speed; the use of bremsstrahlung radiation of high energy, rapid electrons and protons; elaboration and determination of distinct indications to radical and palliative radiation therapy; substantiation of different rhythms of irradiation, intensity of single and total focal dose from radiobiological points of view; profound study of the causes of development of radiation reactions and complications and also elaboration of the methods of their presentation and treatment. (auth)

6926 GENETICALLY SIGNIFICANT DOSE FROM BEAM THERAPY IN JAPAN, 1971. Hashizume, T.; Kato, Y.; Kumamoto, Y.; Yamaguchi, H.; Nishizawa, K. (National Inst. of Radiobiological Sciences, Chiba, Japan). Health Phys.; 26: No. 5, 449-459(May 1974).

The genetically significant dose (GSD) from beam therapy in 1971 was estimated, based on a nationwide survey carried out for a 30 consecutive day period in June and July 1971. From 1480 hospitals which had therapy units, 348 hospitals were selected at random for the survey. Sixty-eight percent of the questionnaires were answered. The contribution to the GSD from beam therapy in Japan was estimated by using the results of experiments on scattered and leakage radiation, designed to allow a reasonable projection of the dose; percentage depth dose tables; and determination of the expected number of children from vital statistics. The GSD estimated was 0.25, 0.70, and 0.03 mrad/person/yr for therapies with ^{60}Co units, conventional x-ray units and high-energy accelerators, respectively. (auth)

6927 BIOLOGICAL HAZARDS OF RADIATION. Dolphin, G. W. (National Radiological Protection Board, Harwell, Eng.). Ann. Rheum. Dis.; 32: No. 6, Suppl., 23-28(Dec 1973).

From symposium on radioactive colloids in the treatment of arthritis; Harrow, Eng. (6 Jul 1973).

The biological significance of the chromosome aberrations observed in lymphocytes and the significance of the radiation dose to body tissues in the patients treated with ^{198}Au or ^{90}Y as reported in the study by Stevenson and others (Ann. Rheum. Dis.; 32: 112 (1973)) are discussed. The risk of cancer after the treatment of rheumatic conditions of the knee by radioactive colloids is considered, and the significance of the finding of large numbers of lymphocytes with chromosome aberrations in a few patients treated with ^{198}Au and ^{90}Y is discussed. It is concluded that ^{90}Y is to be preferred to ^{198}Au, and that methods of reducing the leakage of activity from the knee into the inguinal lymph nodes should be developed. (UK)

6928 MUTATION EFFECTS OF X RAYS. I. Mutagenesis and Effects. Stephan, G. (Bundesgesundheitsamt, Berlin). Roentgen Bl.; 27: No. 2, 75-81(Feb 1974). (In German).

Because of the increasing application of ionizing radiation in the medical field, the population is subjected to a higher radiation exposure. The genetic effect of such radiation is demonstrated and in connection with this the mutagenesis and mutation effects are dealt with. (auth)

6929 IATROGENIC RADIATION SICKNESS. Oprisiu, C. An. Espan. Odontestomatol.; 32: 35-40(1973). (In Spanish).

Clinical examples of radiation sickness in human patients following radiotherapy are briefly described. (JSR)

6930 SENSITIVITY TO IRRADIATION OF THE BRAIN STEM. Berge, G.; Brun, A.; Hakansson, C. H.; Lindgren, M.; Nordberg, U. B. (University Hospital, Lund, Sweden). Cancer; 33: No. 5, 1263-1268(May 1974).

Thirty-three mV x radiation treatment of an oropharynx carcinoma caused injury to the brain stem at the following dose levels: massive necrosis of the brain stem was found in those regions which had received more than 6000 rads; partial necrosis and pronounced reactive changes were found in those regions which had received 5800 to 6000 rads; and edema and mild gliosis were found with decreasing intensity from about 5800 down to 3000 rads. The doses were given during a 40-day period. (auth)

6931 SEXUAL DYSFUNCTION AFTER THERAPY FOR CERVICAL CARCINOMA. Abitbol, M. M.; Davenport, J. H. (State Univ. of New York, Stony Brook). Amer. J. Obstet. Gynecol.; 119: No. 2, 181-189(15 May 1974).

The shortening of the vagina interfered markedly with the sexual function of 22 out of 28 patients with invasive carcinoma of the cervix treated with radiotherapy. Only two out of 32 surgical patients had a sexual interference. The place of sexual function in the life of middle-aged women is emphasized. Preference is given for radical surgery in the management of early carcinoma of the cervix because this mode of therapy interferes minimally with the sexual function. While the rectal and vesical complications have always been emphasized, the vaginal complications and the sexual dysfunction have been previously ignored. (auth)

6932 ACUTE LEUKEMIA FOLLOWING LOCALIZED IRRADIATION FOR CARCINOMA OF THE LARYNX. Karchmer, R. K.; Caldwell, G. G.; Chin, T. D. Y. (Dept. of Health, Education, and Welfare, Washington, DC). Blood; 43: No. 8, 721-725(May 1974).

During a 5-yr leukemia surveillance study in the metropolitan Kansas City area, four patients who had previously received radiation therapy for carcinoma of the larynx developed acute leukemia. The frequency of occurrence represents a significant increase of the observed over the expected. These findings indicate that, even with such localized radiotherapy, the possibility of irradiation-induced leukemia must be considered in therapeutic decisions. (auth)

6933 DENTAL RADIOLOGY: STANDARDS OF GOOD PRACTICE AND TENNESSEE RADIATION PROTECTION REGULATIONS. Gibbs, S. J. (Vanderbilt Univ., Nashville). J. Tenn. Dent. Ass.; 53: 315-321(Oct 1973).

New Tennessee State Regulations for Protection against Radiation, now in effect, are applications of standards of good radiologic practice. Changes have been made in regulations concerning intraoral dental radiography. New standards, governing extraoral dental radiography, have been introduced. Darkroom procedures have been added to the regulations. It is pointed out that sound radiology practice will assure compliance with state regulations. The converse does not necessarily hold: compliance with regulations does not insure practice of sound radiology. (auth)

6934 TREATMENT OF SUPRAGLOTTIC CANCER BY RADICAL HIGH DOSE RADIOTHERAPY. Batsini, J. P.; Ennuyer, A.; Poncet, P.; Ghossein, N. A. (Institut du Radium, Paris). Cancer; 33: No. 5, 1253-1262(May 1974).

Megavoltage radiotherapy was used for treatment of 218 patients with supraglottic cancer. Forty-five percent had positive nodes and 43% had extralaryngeal disease. Absolute 3- and 5-year survival for T1 and T2 lesions was 70 and 60%; for T3 and T4 lesions it was 42 and 35%. Differences in survival between patients with negative nodes and those with mobile nodes was unremarkable. One percent recurred in the neck when there was no palpable node initially. Ninety-five percent of mobile nodes were controlled when the primary was cured. The most common failure site was the larynx. Neither subglottic extension nor specific sites of extralaryngeal involvement worsened the prognosis. Eight had major radiation complications, one fatal, seven requiring tracheotomy. Twenty-five had surgery for recurrence, and seven were salvaged. The present policy is radiotherapy for early tumors, and for T4, if more than total laryngectomy is required. Surgery is reserved for radiation failures and for advanced disease limited to larynx. (auth)

6935 PRESENT STATUS OF RADIUM. Simon, N. (Mount Sinai School of Medicine, New York). N. Y. State J. Med.; 74: No. 5, 822-824(May 1974).

Because of the hazards of handling ^{226}Ra implants used for therapy, safer and effective substitutes have been studied for years. At this point of time, ^{137}Cs is the most acceptable substitute as a γ source for the treatment of cancer, particularly in the uterus. Afterloading is an important feature of modern therapy. Substitute radionuclides like ^{137}Cs can be miniaturized for greater safety. Although ^{226}Ra is still useful, it is gradually being replaced by more advantageous substitute radionuclides. (auth)

6936 ELECTRON BEAM THERAPY OF HEAD AND NECK TUMORS. Tobin, D. A.; Byrd, S. L.; Scott, R. M. (Univ. of Louisville, KY). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 617-623(Mar 1974).

From 74th annual meeting of the American Roentgen Ray Society; Montreal, Quebec (25 Sep 1973).

Electron beam therapy applied by single portals to lesions of lateral border of tongue, buccal mucosa, floor of mouth, alveolar ridge, retromolar trigone, and tonsillar area is well tolerated by patients, and is productive of less permanent damage to tissues of head and neck than photon therapy. Treatment planning is simplified and accurate daily field reproduction more easily accomplished. Control of infectious disease is comparable to photon therapy and the quality of life, following therapy, is improved. (auth)

6937 AGGRESSIVE MANAGEMENT OF ADVANCED HEAD AND NECK TUMORS. Rafla, S.; Bochetto, J. Jr. (Methodist Hospital, Brooklyn). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 608-616(Mar 1974).

From 55th annual meeting of the American Radium Society; Colorado Springs, CO (22 Apr 1973).

Advanced head and neck tumors stand an improved chance of local control after being treated with a radical course of radiation therapy followed by full surgery. This line of management seems to be reasonably well tolerated with an acceptable degree of morbidity and few side effects. It also seems that metastatic lymph nodes respond more readily than primary tumors to biologically equivalent doses. (auth)

6938 CARCINOMA OF THE SOFT PALATE AND UVULA. Seydel, H. G.; Scholl, H. (American Oncologic Hospital, Philadelphia). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 603-607(Mar 1974).

From 74th annual meeting of the American Roentgen Ray Society; Montreal, Quebec (25 Sep 1973).

Most carcinomas of the soft palate and uvula occur in male patients after the fifth decade of life, as is the case for other carcinomas of the upper digestive tract. Successful local treatment by surgery or radiation therapy is possible in the majority of patients. The long term survival, however, depends on the incidence of inter-current disease. Death from such disease appears consistent with its prevalence in the general population of a similar age. The frequency with which second primary cancers occur in this patient group, and the possibility to successfully treat such second primary tumors, makes it desirable to be on the alert for new malignancies and to subject patients who have been successfully treated for cancer of the soft palate and uvula to periodic comprehensive cancer detection examinations. (auth)

6939 RADIATION TREATMENT OF CARCINOMA OF THE NASAL VESTIBULE. Haynes, W. D.; Tapley, N. duV. (Univ. of Texas, Houston). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 595-602(Mar 1974).

From 74th annual meeting of the American Roentgen Ray Society; Montreal, Quebec (25 Sep 1973).

Squamous cell carcinoma of the nasal vestibule is controlled in a high percentage of cases by various modalities of radiation therapy. Of 22 patients treated by irradiation, local control was obtained in 19 patients, with one of three recurrences salvaged by surgery. Cervical lymph node metastases were successfully treated in three patients, whose primary lesions were controlled. Only one patient whose primary lesion was controlled had a major complication. (auth)

6940 VALUE OF RADIATION THERAPY IN THE TREATMENT OF ORBITAL METASTASIS. Huh, S. H.; Nisce, L. Z.; Simpson, L. D.; Chu, F. C. H. (Memorial Sloan-Kettering Cancer Center, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 589-594(Mar 1974).

From 74th annual meeting of the American Roentgen Ray Society; Montreal, Quebec (25 Sep 1973).

A series of 70 cases of extraocular orbital metastases treated by radiation therapy was reviewed. Carcinoma of the breast and lymphoma were the most common types of metastases. Most metastatic lesions occurred in the orbital cavity, particularly in the retrobulbar region. There were 9 cases of bilateral involvement. The clinical manifestations and side effects of these patients are described. Radiation therapy was effective in producing worthwhile palliation. Of the 79 lesions treated, 39 per cent showed marked improvement for an average duration of 17 months, 33 per cent showed slight improvement for a duration of 7 months and 28 per cent failed to respond. The planning of radiation therapy should be individualized according to the location and extent of tumor involvement. The tumor dose recommended is 2,000 to 3,000 rad delivered in about 2 weeks for lymphoma, and 3,500 to 4,000 rad delivered in about 3 weeks for breast carcinoma and other types of cancer. (auth)

6941 RADIATION THERAPY OF TUMORS OF THE EIGHTH NERVE SHEATH. Newman, H.; Sheline, G. E.; Boldrey, E. B. (Univ. of California, San Francisco). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 562-567(Mar 1974).

When feasible, surgical removal of an eighth nerve sheath tumor is the treatment of choice. Of 33 patients who survived following complete surgical extirpation, only one patient had recurrent disease, although he is alive 21 years after the surgical procedure. Frequently the tumor is so adherent to the brain stem or adjacent vessels that complete removal of the lesion is too risky. If subtotal removal is done and not followed by irradiation, recurrence is likely. No recurrent tumors were found in patients who, after incomplete surgical removal of the tumor, received postoperative irradiation of an adequate dose (4,200 to 5,000 rads). (auth)

6942 TREATMENT OF NONFUNCTIONING CHROMOPHOBE ADENOMAS OF THE PITUITARY. Sheline, G. E. (Univ. of California, San Francisco). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 553-561(Mar 1974).

From 74th annual meeting of the American Roentgen Ray Society; Montreal, Quebec (25 Sep 1973).

One hundred and forty patients with chromophobe adenomas of the pituitary were treated by radiation therapy, surgical decompression, or surgical decompression followed by radiation therapy. The initial response of the visual fields was the same for each form of therapy. The long-term control rates at all intervals from 2 to 20 years were, however, much greater when irradiation was given. At 10 years the absolute control rate was 71 per cent for radiation therapy, 79 per cent for decompression plus irradiation, but only 9 per cent for surgery alone. It is probable that results for the irradiated groups would have been better if the doses had been higher in the earlier patients. After 10 years no patient without irradiation was free of recurrence. No major complication could be attributed to irradiation. Surgical procedures, on the other hand, yielded a 7 per cent mortality rate, and 5 per cent of those operated experienced major damage to optic nerves or chiasm. (auth)

6943 OBSERVATIONS ON FIFTEEN INOPERABLE/NON-RESECTABLE CASES OF RECTAL CANCER GIVEN PREOPERATIVE IRRADIATION. Kligerman, M. M.; Urdaneta-Lafee, N. (Yale Univ., New Haven). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 624-626(Mar 1974).

From 55th annual meeting of the American Radium Society; Colorado Springs, CO (22 Apr 1973).

A small series of advanced carcinoma of the rectum treated with intensive preoperative irradiation and yielding a 5-year cumulative survival rate of 20.2% suggests that patients with advanced local disease should be offered such combined treatment to see if these results are maintained in a larger series. A reduction in side effects of radiotherapy was demonstrated. (CH)

6944 PULMONARY FUNCTION FOLLOWING MANTLE-FIELD IRRADIATION FOR HODGKIN'S DISEASE. Evans, R. F.; Sagerman, R. H.; Ringrose, T. L.; Auchinclose, J. H.; Bowman, J. Radiology; 111: No. 3, 729-731(Jun 1974).

Following mantle-field irradiation for Hodgkin's disease, patients experience a transient acute pulmonary reaction resulting in a decreased vital capacity and forced expiratory volume. This reaction begins 2 to 3 months after the start of therapy, reaching a maximum intensity at 4 to 6 months and subsiding by about 8 months. In patients with intrathoracic disease, the improvement following tumor regression may result in a net increase in pulmonary function following treatment. (auth)

6945 RADIATION THERAPY SCHEDULES FOR OPPOSING PARALLEL FIELDS AND THEIR BIOLOGICAL EFFECTS. Ellis, F.; Sorensen, A.; Lescrenier, C. (Medical Coll. of Wisconsin, Milwaukee). Radiology; 111: No. 3, 701-707(Jun 1974).

The nominal standard dose concept was used to evaluate the difference in biological effect at the depth of maximum buildup (d_m) and at the midline for parallel opposed fields. The evaluation was for all field sizes for ^{60}Co γ, and 4, 6, and 22 MV x rays and all separations up to 24 cm. The biological effect is almost always greater at d_m than at the midline and for a given midline dose is much greater if only one field is treated daily as compared with both fields treated daily. (auth)

6946 EFFECT OF RADIATION ON THE HEMATOPOIETIC TISSUE. Hajdukovic, S.; Szirmai, E. (Institut za Nuklearne Nauje Boris Kidric, Belgrade). J. Inst. Nucl. Eng.; 15: No. 1, 15-17 (Jan 1974).

A report is presented on morphological changes of blood cells in irradiated humans and on the radiological responses of hematopoietic organs. (auth)

6947 LUNG CANCER DEATH RATE IN LKAB's MINERS IN MALMBERGET. Renard, K. G. S. Laekartidningen; 71: No. 3, 158-162(1974). (In Swedish).

The frequency of lung cancer among underground workers in the iron ore mines at Malmberget has been investigated. The investigation covers the period 1950 to 1972, but with a more detailed study of active miners during the years 1961 to 1972. A material classified by age has been compared with a reference group for which the annual lung cancer rate has been calculated. In comparison with the reference group there was a considerably higher death rate in lung cancer (14 cases found to ~1 expected) at Malmberget among men in the category of active miners. (auth)

6948 CHROMOSOMES OF PATIENTS TREATED WITH YTTRIUM-90. Jalava, S.; Salonius, A. L. (Turku Univ., Finland). Lancet; 1: No. 7861, 807(27 Apr 1974).

A chromosome study was made of 49 rheumatoid arthritis patients treated with ^{90}Y injected into the knee joint. The mean age was 49 years, and chromosomes were examined from cultured peripheral-blood lymphocytes by a slightly modified Moorhead technique. Before treatment, 2450 cells were examined and 6060 cells afterwards, 30 to 50 cells per culture. The frequency of damaged cells in control cultures was 0.37% and before treatment there were no cells with translocations or deletions and only 9 with dicentrics, fragments or rings. The frequency of damaged cells rose to 1.31% after 1 week, 1.42% after 1 month, had dropped to 1.32% after 6 months and 1.03% after 1 year. (UK)

6949 RADIATION-INDUCED HEAD AND NECK TUMOURS. Gesell, T. F. (Univ. of Texas, Houston). Lancet; 1: No. 7861, 815-816(27 Apr 1974).

Brief comment is made on a previous paper (Modan et al, Lancet p. 277 (Feb. 23, 1974)). There an excess of thyroid cancers was found in a group of x-rayed children who had received 6.5 rads delivered to the thyroid. It is suggested that these findings should not be viewed with surprise, taking into account the linear hypothesis for radiation effects, considering 10 excess cases in a population of 10,902 with 6.5 rads/individual and an observation period of 23 yr, it is estimated that there was an absolute risk of 6.1 cases per 10^6 man-rad-year. (UK)

6950 CHROMOSOMAL DAMAGE IN HUMAN LYMPHOCYTES FROM RADIOISOTOPE THERAPY. Stevenson, A. C. (Medical Research Council, Oxford). Ann. Rheum. Dis.; 32: No. 6, Suppl., 19-22(Dec 1973).

From symposium on radioactive colloids in the treatment of arthritis; Harrow, Eng. (6 Jul 1973).

Five sets of data are considered relating to chromosomal damage in human lymphocytes following radioisotope therapy. These data cover 48 patients treated by intra-articular injections of ^{198}Au with a mean dose of 15.6 mCi, 22 patients treated by intra-articular injections of ^{90}Y with a mean dose of 5.8 mCi, 10 patients from a different hospital also treated with intra-articular injection of ^{90}Y but with a mean dose of 7.7 mCi, 12 patients treated by endolymphatic injections of ^{32}P-labelled lipoidal with a mean dose of 6.1 mCi and 28 patients treated with ^{131}I for hyperthyroidism with a mean dose of 9.5 mCi. The mean damaged cells per mCi per cent, the mean number of dicentric chromosomes per mCi per 100 cells, the mean number of ring chromosomes per mCi per 100 cells and the distribution of dicentric chromosomes, for each of the five sets of patients, are tabulated. All findings were in PHA-stimulated cultures harvested after 48 hours. (UK)

6951 RADIATION PROTECTION IN DIAGNOSTIC X-RAY EXPOSURES. Koga, S.; Yamamoto, C. (Nagoya Univ., Japan). Gendai Igaku; 21: No. 1, 37-39(Jul 1973). (In Japanese).

The effect of radiation on patients in x-ray diagnosis was stated. The survey on radiation protection by medical physicians in Niigata Prefecture was quoted, and in addition, it was mentioned that they are little interested in radiation protection. In order to know the amount of radiation exposure to patients on x-ray examination, dose to the skin of the patients, dose to the gonads, and dose to bone-marrows in photographing various regions were expressed by a model picture, and were compared with the average natural radiation dosage per year. In considering the radiation dose to the whole people, radiation dose by medical treatment was stated to be extremely large amount of dose than that by environmental pollution except the natural radiation dose. It was stated that doses to gonads and bone marrows were largely influenced by alimentary examination of the gastrointestinal tract. When scintiscanning of the liver was done by ^{198}Au-colloid, 8 R to the liver was irradiated in the diagnosis with radioisotope. In addition, radiation dose was 12 rads in diagnosis of the thyroid gland with 1 μCi of ^{131}I. The report by ICRP on the estimation of profit and loss by radiation was quoted. In conclusion, the education about radiation protection and clinical judgement on x-ray diagnosis were referred from the point of medical physicians. (JA)

6952 RADIOBIOLOGY OF FAST NEUTRON THERAPY. Orii, H. (National Cancer Center, Tokyo). Tokyo Igaku; 80: No. 2, 93-102(Sep 1972). (In Japanese).

Radiotherapy of neoplasms by fast neutron was described including conclusions of symposiums held in the Netherlands in May of 1970 and at Oak Ridge in 1969. Elastic collision of fast neutron was described and it was compared with physical characters of x ray or gamma ray. As fast neutrons for clinical use, the following four kinds of neutrons were mentioned and their practical uses were also described respectively: fast neutron by nuclear fission of an atomic pile and uranium, fast neutron by fission of californium, fast neutron radiated when deuterohydrogen was accelerated by cyclotron and it struck beryllium, and fast neutron radiated when deuterohydrogen (D) was accelerated by D–T type neutron generator and struck tritium (T). Deep dose rate of fast neutron was compared with that of ^{60}Co gamma ray or x ray, and buildup of neutron dose and decision of irradiation field were also described. With respect to relative biological effectiveness (RBE) of fast neutron, therapeutic effect and radiation damage were mentioned as compared with those of x ray or gamma ray. Oxygen deficit in neoplasms was described and furthermore oxygen enhancement ratio (OER) of fast neutron used in therapy of neoplasms associated with oxygen deficit was shown. Recovery of cells which were given fast neutron irradiation was also described by putting an emphasis on Elking-Sutton type recovery. Moreover, whole therapy, application to medical use, measurement of dose, RBE, and OER concerning fast neutron were mentioned in the end including references of symposiums and reviews. (JA)

6953 EPITHELIOMAS OF THE SCALP AFTER IRRADIATION. Ridley, C. M. (Whittington Hospital, London); Spittle, M. F. Lancet; 1: No. 7856, 509(23 Mar 1974).

It is pointed out that, although basal-cell epitheliomas can develop in a short period of time following irradiation of the scalp for ringworm, a longer latent period is to be expected for the development of such slow-growing tumors. A basal-cell carcinoma on the hairy scalp should lead the clinician to enquire about the

history of irradiation, since in the absence of such a history lesions at this site are uncommon. (UK)

6954 RESULTS AND COMPLICATIONS OF THE TREATMENT OF BECHTEREW'S DISEASE WITH THORIUM X. Laschner, W. (Univ., Leipzig). Z. Orthop. Ihre Grenzgeb.; 111: No. 5, 743-748(Oct 1973). (In German).

Good subjective results of Thorium X treatment of Bechterew's disease were tested by clinical examination both before and after treatment. In 51 patients an increase in joint-range could be ascertained. Undesirable side-effects are also described. During radiotherapy we saw nine cases of iridocyclitis, one case of gastric ulcer, and another with normochromic anemia. Tests of serum lability, normal before the start of treatment became abnormal during or after it in a comparatively large number of cases. A further number of cases was submitted to chemical tests, where Thorium X therapy had been given more than 3 yrs previously. Here, too, chemical changes were found, but no actual damage could be proved. (GE)

6955 UROLOGICAL COMPLICATIONS AFTER RADIOTHERAPY OF THE COLLUM AND CORPUS CARCINOMA. Kling, H. Munich; Univ. Munich (1971). 46p. (In German).

Thesis.

In the past, both surgery and radiotherapy of the collum and corpus carcinoma frequently led to severe complications, predominantly in the urinary tract, which could be kept within tolerable limits only after certain improvements had been achieved in the methods and techniques applied. In order to keep the radioinduced lesions within the lowest possible limits, careful calculations have to be done to adjust the doses to be applied to the individual requirements and to irradiate only a minimum of tissue. Care must also be taken to cure any existing infections of the urinary tract prior to the irradiation, and patients have to be strictly examined during and after radiotherapy in order to detect and treat developing urinary tract infections. Apart from a few exceptional cases, severe lesions of the skin and radiogenic fistulae can nowadays be avoided. Light damages such as radiation-induced cystitis, superficial ulcera of the bladder and ureteral strictures will frequently heal without treatment, or can be successfully treated by conventional methods. If not, surgical therapy is required. There is a large number of surgical measures that can be applied to restore the continuity of the urinary tract. Discharge of urine through the skin should, of course, be avoided whenever possible. Surgical treatment will only be successful when applied not earlier than 12 months following the termination of radiotherapy, and only when a recurrence of tumor activity can be safely excluded. Surgical treatment during or shortly after radiotherapy will only bring about transient improvements in the patient's condition. (GE)

6956 MEDICAL EXAMINATION. Hinz, G. (Bundesgesundheitsamt, Berlin); Moehrle, G.; Zimmer, F. (1973). vp. (In German).

From 14th annual meeting of the Vereiningung Deutscher Strahlenschutzaerzte eV; Wuerzburg, Ger. (16 Nov 1973).

The basic regulations of Euratom for the medical examination of personnel working in controlled areas, which have been set up in accordance with the recommendations of the JCRP, give a clear definition of the term medical control which is discussed. The draft of a new version currently under discussion calls for an extension of the qualifications to be fulfilled by the physician responsible for medical control, stipulating that physicians should have a special knowledge of health physics. Some examples are given of appropriate regulations in European countries other than members of the EC. The regulations of the new X-ray Decree relating to medical control, laid down in paragraphs 42 to 46, are briefly explained. In order to contribute to a harmonization of the various regulations governing medical control, it has been decided for the time being to adhere to the principles given in the Instructions for the medical control of personnel working in controlled areas in accordance with the First Radiation Protection Decree, which provides for physical examination of the whole body and for additional laboratory tests. It will be the task of the Federal Public Health Office to establish the guidelines for the application of the new standard regulations after these have been officially accepted. (GE)

6957 DO WE NEED A COMPUTER? A Review of Data Processing Applications in Nuclear Medicine and Radiotherapy. Edwards, D. N. (Liverpool Regional Radiotherapy Centre). Clin. Radiol.; 25: No. 1, 9-25(Jan 1974).

From spring meeting of the therapy section; Liverpool, England (10 Mar 1973).

A policy for the use of computers has been suggested by the Department of Health. Guidance in the application of this policy must come from clinicians, based on informed opinion. A brief review of the current situation and of development work is presented. (auth)

Vertebrates

Refer also to abstracts 6833, 7131, 7163, 8984, and 8987.

6958 (AEC-tr-7471) RADIOBIOLOGY, VOL. 13, NO. 3, 1973. Translation of Radiobiologiya; 13: No. 3, 323-480(1973). 202p. Dep. NTIS $7.60.

Separate abstracts were prepared for the 35 papers presented in this publication. (ERB)

For abstracts of individual papers see: 6829-6832, 6849, 6855, 6856, 6875-6878, 6959-6979, 7139, 7172, and 8559.

6959 (AEC-tr-7471, pp 1-6) COMPARATIVE ANALYSIS OF THE PYRIMIDINE NUCLEOTIDE BLOCKS OF DNA IN RADIATION SICKNESS AND LEUKEMIA. Kritskii, G. A.; Aleksandrov, S. V.; Batishchev, A. I.; Litavrin, V. A. (Inst. of Biochemistry, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 323-327(1973).

The pyrimidine nucleotide blocks of DNA of the hematogenic system during radiation sickness and leukemia of animals were investigated by paper chromatography. It was found that both after the influence of ionizing radiation on the animal organism and in the investigated forms of leukemia (radiation leukemia Ls of $C_{57}Bl_6$ mice, Schwelz leukemia in rats, and spontaneous leukemia of cows), the total content of certain tri- and dinucleotide blocks of DNA is reduced, whereas the total content of certain other dinucleotides blocks and single nucleotide residues is increased. Some peculiarities of the block structure of DNA were also detected in the case of radiation sickness and various forms of leukemia in animals. (tr-auth)

6960 (AEC-tr-7471, pp 7-15) INFLUENCE OF IRRADIATION ON THE PHOSPHORYLATION OF NUCLEAR PROTEINS. Paskevich, I. F.; Stolyarov, I. V.; Likhoded, V. S. (Scientific Research Inst. of Medical Radiology, Kharkov). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 328-334(1973).

The influence of irradiation on the phosphorylation of the nuclear proteins in vivo was studied. It was established that irradiation activates the phosphorylation of histone and nonhistone proteins in the liver in the first periods of radiation sickness. An inhibition of synthesis and phosphorylation of the investigated proteins is observed in the spleen. In both organs a redistribution of the protein fractions was established after irradiation. (tr-auth)

6961 (AEC-tr-7471, pp 16-21) METABOLISM OF PHOSPHOLIPIDS AND CHOLESTEROL IN THE RAT BRAIN AFTER THE INFLUENCE OF IONIZING RADIATION. Kolomitseva, I. K.; Vasil'ev, A. V. (Inst. of Biological Physics, Pushchino, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 335-339(1973).

It was shown that 24 hrs after x irradiation of rats at a dose of 400 R, the amount of phospholipids in the brain increases (by 8%) and the amount of sphingomyelin decreases by 20%; in this case a 71% inhibition of the incorporation of $2^{14}C$-acetate into sphingomyelin and a 50% inhibition of incorporation into cholesterol are observed. Irradiation at a dose of 800 R causes a decrease in the amount of phosphatidylethanolamine and an increase in cholesterol. There are no changes in the incorporation of $2^{14}C$-acetate into the lipids of the rat brain during irradiation at a dose of 800 R. (tr-auth)

6962 (AEC-tr-7471, pp 22-32) ELECTROPHORETIC AND IMMUNOCHEMICAL INVESTIGATION OF PROTEINS AND CERTAIN ENZYMES OF THE MUCOUS MEMBRANE OF THE STOMACH AND SMALL INTESTINE OF RATS IN ACUTE RADIATION SICKNESS. Surinov, B. P.; Sharetskii, A. N.; Kashkin, K. P. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 340-348(1973).

The irradiation of rats with γ rays at a dose of 1000 R already causes a decrease in the content of certain isoenzymes of the carboxyl and acetyl esterases, aspartate aminotransferase, an increase in the activity of acid phosphatase, as well as a selective disruption of the content of protein fractions differing in electrophoretic mobility in agar gel, after 6 to 12 h. A decrease is observed in the content of tissue-species-specific glycoprotein of the mucin-secreting cells in both mucosa and the organ-specific antigen of the principal cells of the gastric glands. These disorders are especially pronounced by the third day—the time of death of the irradiated animals. (tr-auth)

6963 (AEC-tr-7471, pp 40-46) QUANTITATIVE CYTOLOGICAL ANALYSIS OF THE BONE MARROW SYNDROME UNDER THE INFLUENCE OF IONIZING RADIATION. Strzhizhovskii, A. D. Apr 1974. Translated from Radiobiologiya; 13: No. 3, 355-360(1973).

A quantitative analysis was made of the dynamics of bone marrow destruction of irradiated mice and rats. It was shown that the curve in the drop of the number of karyocytes can be approximated by the sum of two exponents, one of which (about 80% of the cells) reflects the consequences of a mitotic block, while retaining a normal rate of migration of the cells on the periphery, while the second reflects interphase death of cells. The drop in the number of erythrocytes in the peripheral blood is due to their death in the process of natural aging. No significant reserve of erythrocytes is detected. The values of the characteristic constants of the dynamics of destruction and the nature of their dependence on the dose of irradiation were determined. (tr-auth)

6964 (AEC-tr-7471, pp 55-61) INFLUENCE OF THE DOSE RATE OF IRRADIATION ON PROCESSES OF DAMAGE AND RECOVERY OF COLONY-FORMING BONE MARROW CELLS. Chertkov, K. S. (Inst. of Biophysics, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 368-372(1973).

The influence of γ irradiation at a dose of 800 R and rates of about 500 and 0.28 R/min on the number of colony-forming units (CFU) of the bone marrow was followed. The rate of recovery of the CFU after irradiation at a low dose rate is not impaired, and it is modeled by an exponential function for a period of three weeks. The process of recovery of CFU after irradiation at a high dose rate is blocked for several days, and the recovery, developing later, is an exponential function of the time. The doubling time of CFU in the phase of logarithmic growth is 38 and 67 h after irradiation with high and low dose rates, respectively. (tr-auth)

6965 (AEC-tr-7471, pp 62-67) ABSENCE OF CORRELATION BETWEEN THE INFLUENCE OF SYMPATHICOMIMETICS ON THE BLOOD FLOW IN THE INTERNAL ORGANS, THE OXYGEN TENSION, AND THE SURVIVAL OF IRRADIATED ANIMALS. Kulinskii, V. I.; Zolochevskaya, L. I. (Krasnoyarsk Medical Inst., USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 373-376(1973).

Radioprotective doses of catecholamines increase or do not change the blood flow in radiovulnerable organs of mice. In the spleen, liver, and muscles no positive correlation is detected between the influence of sympathicomimetics (SM) on the blood flow and the oxygen (pO_2). There is no interrelationship between the effects of SM on the blood flow in the spleen and bone marrow and on the survival of mice. These data do not confirm the hypotheses of a deciding role of circulatory hypoxia in the radioprotective effect (RPE) of SM. No negative correlation of the blood flow and thiol concentration in the spleen is detected. (tr-auth)

6966 (AEC-tr-7471, pp 68-73) ANALYSIS OF CERTAIN QUANTITATIVE INDICES OF THE STATE OF THE SYSTEM OF HEMATOGENESIS FOR THE EVALUATION OF THE RADIOPROTECTIVE ACTION OF MEXAMINE. Aizina, N. L.; Ovakimov, V. G.; Suslikov, V. I.; Yarmonenko, S. P.; Airapetyan, G. M. (Inst. of Labor Hygiene and Occupational Diseases, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 377-381(1973).

The correlation between two indices of the state of the system of hematogenesis and the magnitude of the radioprotective effect of 5-methoxytryptamine was studied. It was shown in experiments on mice that such quantitative indices as the number of endogenous colonies per spleen and the total number of nucleated bone marrow cells do not permit a sufficiently accurate estimate of the degree of protective action of a protector. (tr-auth)

6967 (AEC-tr-7471, pp 74-80) INFLUENCE OF SPLENECTOMY AND A RADIOPROTECTIVE AGENT (AET) ON THE SURVIVAL AND STATE OF THE HEMATOGENIC SYSTEM OF IRRADIATED MICE. Baskina, N. F.; Nekrasova, I. V.; Graevskii, E. Ya.; Rakhmanina, O. N. (Inst. of Developmental Biology, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 382-387(1973).

Splenectomy, performed 14 days before irradiation at a dose of 650 R, does not change the protective effect of AET. The survival of the animals, initial lesion and postradiation recovery of the bone marrow and thymus do not differ in splenectomized and intact animals. The curves of regeneration of various cell populations of the bone marrow, differing sharply in protected and unprotected mice, are monotypic for splenectomized and intact animals. The role of the spleen in the restoration of hematogenesis, and, consequently in the survival of the animals, is determined by the ability of other portions of the hemopoietic system to compensate for its absence. (tr-auth)

6968 (AEC-tr-7471, pp 81-87) DURATION OF THE RADIOPROTECTIVE ACTION OF SODIUM-AMINOETHYLTHIOPHOSPHATE (CYSTAPHOS) IN MICE. Mishustova, Ya.; Novak, L.; Kautska, I. (Inst. of Biophysics, Brno). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 388-392(1973).

The interrelationship of the changes in the respiratory gas exchange and the protective action after the introduction of cystaphos in doses of 450 to 1000 mg/kg in mice of the H line is described. It was shown that in the region of nontoxic doses of cystaphos, an increase in the dose enhances the decrease in the oxygen consumption and increases the protective action of the preparation. The duration of the protective action of cystaphos, which depends on the dose of irradiation, corresponds to the duration of inhibition of the respiratory gas exchange. The results are evidence that the change in the energy metabolism and the change in the radioresistance of the organism after the administration of cystaphos are similar. (tr-auth)

6969 (AEC-tr-7471, pp 88-93) PROBLEM OF INTENSIFICATION OF THE BIOLOGICAL ACTION OF IONIZING RADIATION. Communication 7. The Indirect Component in the Antitumoral Radiation Effect. Rampan, Yu. L; Yarmonenko, S. P.; Berezhnova, L. I. (Inst. of Experimental and Clinical Oncology, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 393-397(1973).

It was established in experiments on noninbred white mice with multiple cancer of the mammary glands that in the case of a single local γ or proton irradiation of the main tumor node at a dose of 1000 rad, there may be an inhibition of the growth of nonirradiated foci as well, accompanied by an increase in the lifetime of the animals. In the presence of an indirect antitumoral effect, the direct influence of irradiation on the tumor was also enhanced. Preliminary (before irradiation) administration of antilymphocyte serum eliminated the indirect inhibition of growth of the nonirradiated tumor. An analysis of the data obtained indicates the possibility of the participation of immunological mechanisms in the radiation therapy of tumors. (tr-auth)

6970 (AEC-tr-7471, pp 94-104) NEURORADIOBIOLOGICAL EFFECTS IN THE CASE OF HEMILATERAL IRRADIATION OF THE RABBIT BRAIN. Communication 2. Dynamics of the Change in the Spontaneous and Induced Activity of the Visual Cortex Under Conditions of the Transplantation of the Corpus Callosum. Nadareishvili, K. Sh.; Bakradze, O. S.; Dashniani, M. G.; Sandodze, V. Y. (Inst. of Physiology, Tbilisi, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 398-406(1973).

In chronic experiments with preliminary removal of the corpus callosum we studied the dynamics of the change in ECoG of the visual regions during irradiation of one of the hemispheres of the brain. It was discovered that under these conditions the spasmodic activity that develops under these conditions after irradiation does not spread to the cortex of the shielded hemispheres, whereas spontaneous, and especially induced activities undergo substantial changes in both directions. In the dose range 50 to 75 krad of continuous hemilateral irradiation, including the conditions of callosotomy, there is a temporary bilateral depression of the evoked potentials (EP). After this, spontaneous spindles appear on the ECoG and the EP are restored, at first against a background of the effect of the slow cortical aftereffect (SCA), and after a series of paroxisms lateralized on the side of irradiation, individual EP again begin to be recorded. (tr-auth)

6971 (AEC-tr-7471, pp 124-128) CHANGE IN THE ACTIVITY OF URIDINE AND THYMIDINE PHOSPHORYLASES IN THE SPLEEN, THYMUS, AND BONE MARROW OF RABBITS AFTER WHOLE-BODY X IRRADIATION. Filanovskaya, L. I.; Filippova, V. N. (Scientific Research Inst. of Hematology and Blood Transfusion, Leningrad). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 423-426(1973).

The influence of whole-body x irradiation at a dose of 1000 R on the activity of uridine and thymidine phosphorylases of the spleen, thymus, and bone marrow of rabbits was studied. In the spleen and thymus, 24 h after irradiation, the activity of the enzymes increased sharply, while in the bone marrow it decreased. The inhibition of the activity of nucleoside phosphorylases of the bone marrow of irradiated animals was caused by a suppression chiefly of the activity of extracellular enzymes. (tr-auth)

6972 (AEC-tr-7471, pp 139-143) SUPPRESSION BY AURANTIN OF THE OXIDATIVE PHOSPHORYLATION OF LIVER MITOCHONDRIA DURING IRRADIATION. Sukhanova, G. A.; Dokshina, G. A. (Tomsk State Univ., USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 433-437(1973).

The inhibitor of protein synthesis aurantin, administered one day before irradiation, lowered the RNA and protein content, suppressed the effect of restoration of oxidative phosphorylation of rat liver mitochondria, observed after irradiation, and inhibited the survival of Mongolian gerbils, which are more resistant to irradiation. The dependence of the radioresistance of the organism on the intensity of recovery processes in the liver mitochondria is discussed. (tr-auth)

6973 (AEC-tr-7471, pp 147-149) INFLUENCE OF GAMMA IRRADIATION AND SPLENECTOMY ON THE CONTENT OF ANTIBODY-FORMING CELLS IN VARIOUS ORGANS OF RABBITS. Zolotnikova, G. P.; Prokopenko, L. G. (Kursk State Medical Inst., USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 439-441(1973).

The influence of γ irradiation and splenectomy on the content of antibody-forming cells in various organs of rabbits was studied. The partial blocking of lymphoid tissue in the case of irradiation or splenectomy led to an increase in the number of antibody-forming cells in the liver and lungs, and irradiation caused more profound changes than splenectomy. In the spleen and lymph nodes of irradiated rabbits, the number of antibody-forming cells was significantly lower than in healthy animals. (tr-auth)

6974 (AEC-tr-7471, pp 150-154) RADIOACTIVITY OF LOACH EGGS DURING CLEAVAGE UNDER CONDITIONS OF COLCHICINE-INDUCED DEPRESSION OF MITOSIS. Smirnova, I. B.; Latsis, R. V.; Frolova, E. V. (Inst. of Developmental Biology, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 442-445(1973).

Loach eggs during cleavage, in which mitotic changes in the chromosomes were suppressed by the influence of colchicine, while fluctuations in the thiol level remained the same as in normal eggs, were irradiated. The changes in radiosensitivity (according to the value of the percent of embryos surviving 24 h after irradiation) in normal and colchicine-treated eggs are synchronized in time and have the same direction, despite the difference in the state of the chromosomes. It was concluded that endogenous thiols play a significant role in the radiosensitivity of the cell. (tr-auth)

6975 (AEC-tr-7471, pp 164-168) INVESTIGATION OF THE REACTIVITY OF CERTAIN BIOCHEMICAL SYSTEMS OF BIRDS UNDER THE INFLUENCE OF IONIZING RADIATION. Shabalina, A. T.; Rusev, G. K. (Inst. of Animal Husbandry, Kostinbrod, Bulgaria). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 452-455(1973).

Two groups of birds (Gallus domesticus) with different genotypes of blood catalase were investigated. The higher radioresistance observed among hypocatalase birds is probably associated with a substantial activation of glutathione peroxidase during irradiation and a lower formation of organic peroxides. The increased radioresistance of these birds (in comparison with mammals) may be associated with activation of cytochrome oxidase in all the organs and tissues during irradiation. (tr-auth)

6976 (AEC-tr-7471, pp 169-172) SHIELDING OF THE THYMUS AND PART OF THE BONE MARROW DURING IRRADIATION: A MODEL FOR THE STUDY OF THE INTERACTION OF T- AND B- CELLS IN SITU. Khaitov, R. M.; Ruzybakiev, R. M. (Samarkand Medical Inst., USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 455-458(1973).

A model of the interaction (cooperation) in immunocompetent cells, arising from the thymus and bone marrow under in situ conditions, is proposed. A synergism between the thymus and bone marrow in the induction of immunogenesis when they are both shielded has been detected by the method of detection of individual antibody-forming cells in the spleens of lethally irradiated mice with shielding of the thymus or part of the bone marrow or combined shielding of both these tissues. The model can serve as a convenient system for the search for substances and agents that influence the cooperation of various types of immunocompetent cells during immunogenesis. (tr-auth)

6977 (AEC-tr-7471, pp 173-175) PECULIARITIES OF THE DEATH OF RATS AFTER IRRADIATION IN SUPERLETHAL DOSES. Sheyanov, G. G.; Dergachev, V. I.; Shchelkonogova, L. N. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 458-460(1973).

It was shown that the dynamics of the death of rats of the Wistar line after their irradiation at doses of 1.5, 3, 7, and 15 kR is different and paradoxical: the lifetime of the animals irradiated at doses of 7 and 15 kR was significantly greater than for rats irradiated at doses of 1.5 and 3 kR. (tr-auth)

6978 (AEC-tr-7471, pp 176-180) EARLY IMMUNOLOGICAL RESPONSE OF THE ORGANISM TO IRRADIATION. Ivanov, A. A.; Nevinnaya, A. P. (Inst. of Biophysics, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 460-464(1973).

The dynamics of the change in the amount of naturally encountered antibodies for homologous tissue antigens and heterologous erythrocytes, as well as the level of complement in the first hours and days after total γ irradiation of rabbits at a dose of 900 R, were observed. The data obtained—the decrease in the level of complement and antitissue antibodies in the first hours after irradiation—are discussed from the standpoint of similarity between the primary response to irradiation and the anaphylactic reaction. (tr-auth)

6979 (AEC-tr-7471, pp 181-184) RADIOPROTECTIVE EFFECTIVENESS OF PERORAL ADMINISTRATION OF MEXAMINE IN DOGS. Chernov, G. A.; Trushina, M. N.; Suvorov, N. N. (Inst. of Biophysics, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 464-466(1973).

Peroral administration of mexamine to dogs in amounts of 100 mg/kg 15 min before irradiation at a dose of 380 R, followed by treatment with antibiotics during the period of increase in body temperature, increases the survival of the irradiated animals to 69%. The isolated use of mexamine proved ineffective. (tr-auth)

6980 (AEC-tr-7499) RADIOBIOLOGY. Translated from Radiobiologiya; 13: No. 4, 483-648(1973). 209p. Dep. NTIS $7.60.

Separate abstracts were prepared for the 35 papers included. (ERB)

For abstracts of individual papers see: 6833, 6834, 6879-6882, 6981-7008, and 7120.

6981 (AEC-tr-7499, pp 9-13) EFFECTS OF IONIZING RADIATION ON THE INDUCTION OF THE SYNTHESIS OF GLUCOSE-6-PHOSPHATASE IN THE RAT LIVERS DURING EMBRYOGENESIS. Slozhenikina, L. V.; Kudryavtseva, A. A.; Kuzin, A. M. (Inst. of Biological Physics, Pushchino, USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 489-492(1973).

In experiments on embryos of white rats, irradiated in utero at a dose of 200 R, it has been shown that the effect of γ irradiation on the activity of glucose-6-phosphatase in the liver of a 21-day embryo depends on the stage of embryogenesis at the moment of the influence of ionizing radiation. Irradiation in the initial period of organogenesis (7 to 9 days) lowered the glucose-6-phosphatase activity, while irradiation before the actual beginning of functioning of the thyroid gland (14 days) and in the period of its secretory activity (19 days) did not inhibit the glucose-6-phosphatase activity. Thyroxin, administered to the embryos on the 20th day of development, after γ irradiation on the 7th day, increased the glucose-6-phosphatase activity 24 hrs after introduction. It is concluded that γ irradiation has an injurious effect on the system of induction of glucose-6-phosphatase synthesis in the embryonic period of ontogenesis. (tr-auth)

6982 (AEC-tr-7499, pp 14-20) RELATIVE ROLE OF VARIOUS PRECURSORS IN THE POSTRADIATION SYNTHESIS OF GLYCOGEN IN THE RAT LIVER. Kendysh, I. N. (Inst. of Biophysics, Moscow). 1973. Translated from Radiobiologiya; 13: No. 4, 493-497(1973).

In the investigation of the synthesis of liver glycogen from glucose-1-^{14}C, glycerin-1,2-^{14}C, lactate-1-3-^{14}C, and glycine-1-^{14}C, it was established that during the period of postradiation increase in the glycogen content (6 to 48 hrs), glycogen synthesis from glucose-1-^{14}C and glycine-1-^{14}C is increased, but not from other precursors. This is evidence of a simultaneous stimulation of glycogenesis and gluconeogenesis. Consequently, during the process of gluconeogenesis, the main precursors of glycogen are amino acids. It is postulated that gluconeogenesis from amino acids of radiosensitive tissues should be considered as the basic mechanism of glycogen synthesis in the livers of irradiated animals, and that glycogenesis is a process secondarily dependent on the induction of gluconeogenesis. (tr-auth)

6983 (AEC-tr-7499, pp 21-26) INFLUENCE OF IONIZING RADIATION ON THE PROTEOLYTIC ACTIVITY OF VARIOUS SUBCELLULAR STRUCTURES OF THE RAT LIVER. Krasnikov, E. V.; Rudakov, V. V.; Ivanov, I. I. (Military-Medical Academy, Leningrad). 1973. Translated from Radiobiologiya; 13: No. 4, 498-502(1973).

The proteolytic activity of the subcellular structures of the rat liver is unchanged during the first hours after irradiation at a dose of 500 R, but it is substantially increased after irradiation at a dose of 1200 R. The fraction of lysosomes in the total activity of the homogenate is lowered, while the fraction of the supernatant liquid is substantially increased. On the 12th day after irradiation at a dose of 500 R and on the fourth day after irradiation at a dose of 1200 R, these changes are even more pronounced. (tr-auth)

6984 (AEC-tr-7499, pp 27-32) FLUCTUATION RATES OF THE SURFACE PRESSURE OF MONOMOLECULAR LAYERS OF BLOOD SERUM PROTEINS OF ANIMALS X-IRRADIATED WITH LETHAL AND SUBLETHAL DOSES. Tkach, V. K.; Dyakov, V. A. (Vinnitsa Medical Inst., USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 503-507(1973).

The fluctuation rates of the elastic properties of monomolecular layers of blood serum proteins of dogs x-irradiated with lethal and sublethal doses were studied. It was shown that the intensity of the fluctuation of the surface pressure of monolayers of blood serum proteins is significantly changed in comparison with the control, depending on the dose of irradiation and the postradiation state of the animals. (tr-auth)

6985 (AEC-tr-7499, pp 39-47) RADIOCHROMATOGRAPHIC INVESTIGATION OF THE CONVERSIONS OF AET AND APT IN THE MAMMALIAN ORGANISM, IN ISOLATED TUMOR CELLS, AND IN AQUEOUS SOLUTIONS. Mandrugin, A. A.; Tarasenko, A. G.; Nekrasova, I. V.; Fedoseev, V. M. (Moscow State Univ.). 1973. Translated from Radiobiologiya; 13: No. 3, 513-519(1973).

On the basis of a radiochromatographic investigation of the behavior of 2-aminoethylisothiuronium and 3-aminopropylisothiuronium in the organism, isolated tumor cells, and in aqueous solutions, it was concluded that the reaction of formation of mercaptoalkylguanidines is not essential for the manifestation of radioprotective activity by these compounds. The results obtained permit the establishment of a relationship between the radioprotective activity and the ability of aminoalkylthiuronium compounds to be converted to cyclic products under the conditions of the organism. (tr-auth)

6986 (AEC-tr-7499, pp 48-54) INFLUENCE OF AMINOTHIOLS AND THEIR COMBINATIONS WITH SYMPATHIOCOTROPIC SUBSTANCES ON THE THIOL CONCENTRATION IN HEMATOGENIC TISSUE. Kulinskii, V. I.; Murskikh, A. P. (Krasnoyarsk Medical Inst., USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 520-525(1973).

It was found in experiments on white mice that the increase by cystamine (CA) in the level of protein thiols, in contrast to nonprotein thiols, may be mediated by mobilization of catecholamines (CatA). Theophylline, like the catecholamines, primarily increases the level of protein thiols. The potentiation of the radioprotective effect of CA by cocaine and the potentiation of the radioprotective effect of a combination of CA+AET by combinations of dibenzamine with anapriline (inderal) or noradrenaline (NA) are not accompanied by an increase in the thiol increasing effect in the spleens of mice and the bone marrow of rats. Possible causes of the dissociation and the role of the 3', 5'-AMP system in the action of radioprotectors are discussed. (tr-auth)

6987 (AEC-tr-7499, pp 55-60) INFLUENCE OF THE PROTEIN FRACTION OF THE SPLEEN ON THE POSTRADIATION RESTORATION OF HEMOPOIESIS. Moroz, B. B.; Bezin, G. I.; Vasil'evskaya, V. V.; Dobromyslova, R. V.; Kendysh, I. N.; Pantyushina, N. N. (Inst. of Biophysics, Moscow). 1973. Translated from Radiobiologiya; 13: No. 4, 526-530(1973).

A protein fraction was isolated from the mouse spleen by gel filtration on Sephadex G-200, the administration of which substantially accelerates the restoration of the bone marrow, thymus, spleen, and blood leukocytes and increases the survival of lethally irradiated mice. (tr-auth)

6988 (AEC-tr-7499, pp 61-68) RADIOBIOLOGY OF STEM CELLS OF THE INTESTINAL EPITHELIUM. Communication I. Comparison of the radioprotective effect of AET according to the 4 to 5 day death rate of mice after irradiation and according to survival of stem cells of the small intestinal epithelium. Knoplyannikova, O. A.; Konoplyannikova, A. G. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 531-536(1973).

The administration of AET to mice before irradiation leads to a decrease in their death rate in a period of 4 to 5 days after irradiation and increases the survival of stem cells of the epithelium of the small intestine. An analysis of the dose dependences showed that there is a strict correspondence between the level of survival of the stem cells of the epithelium of the small intestine and the death rate of the animals in the intestinal peak of death. (tr-auth)

6989 (AEC-tr-7499, pp 69-73) ULTRASTRUCTURE OF CELLS OF THE ADENOHYPOPHYSIS UNDER THE ACTION OF IONIZING RADIATION. Khamidov, D. Kh.; Shaikhov, R. T.; Mirakhmedov, A. K. (Inst. of Biochemistry, Tashkent). 1973. Translated from Radiobiologiya; 13: No. 4, 537-540(1973).

The adenohypophysis has been studied by cytochemical and electron microscopic methods in the normal state and after whole-body irradiation. It was shown that depending on the stage of the secretory process, the cell elements of the adenohypophysis differ in the state of intracellular organoids and content of glycoproteins, DNA, RNA, and lipids. The response of the adenohypophysis to the radiation influence is of a wave-like nature and is accompanied by destructive processes, expressed in a reduction of the cristae of the mitochondria, an expansion of the cisternae and vacuoles of the Golgi complex, and a decrease in the number of secretory granules. (tr-auth)

6990 (AEC-tr-7499, pp 74-79) CURVES OF THE TEMPERATURE DEPENDENCE OF RADIATION DAMAGE TO EHRLICH'S ASCITIES CARCINOMA CELLS AT VARIOUS CONCENTRATIONS OF CELL SUSPENSIONS. Alekseeva, D. I.; Tsarapkin, L. S. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). 1973. Translated from Radiobiologiya; 13: No. 3, 541-545(1973).

A comparison of the curves of the dependence of the radiation effect on the temperature in the range from 0 to 40°C, obtained at various concentrations of suspension of Ehrlich's ascites carcinoma cells, permits us to conclude that the sensitizing effect of reduced temperatures is associated with the greater oxygen content in the irradiated ascite at these temperatures. (tr-auth)

6991 (AEC-tr-7499, pp 86-90) MECHANISM OF THE RADIOPROTECTIVE AND TOXIC EFFECTS OF CERTAIN METHEMOGLOBIN FORMERS. Krasil'nikov, I. I.; Parfenov, A. I.; Strel'nikov, Yu. E.; Smirnova, S. M. (Military-Medical Academy, Leningrad). 1973. Translated from Radiobiologiya; 13: No. 4, 551-554(1973).

For a study of the relationship between the methemoglobin forming, hypoxic, and radioprotective effect of sodium nitrite and para-aminopropiophenone (PAPP) in experiments on mice, we used chemical compounds that prevent the oxidation of hemoglobin. It was shown that isonicotinic acid and one of the derivatives of phenazine, lowering the methemoglobin level, also weaken the tissue hypoxia and the radioprotective effectiveness of the protectors used. The acute toxicity of sodium nitrite is determined by its methemoglobin forming properties, while for PAPP no such correlation was detected. (tr-auth)

6992 (AEC-tr-7499, pp 91-95) DETERMINATION OF THE RADIOPROTECTIVE ACTION OF MEXAMINE UNDER CONDITIONS OF LOCAL AND WHOLE-BODY IRRADIATION ACCORDING TO THE NUMBER OF ABERRANT MOUSE BONE MARROW CELLS. Rogozkin, V. D.; Preobrazhenskii, Yu. Yu.; Strashnenko, S. I.; Kosarenkov, V. A. (Inst. of Biophysics, Moscow). 1973. Translated from Radiobiologiya; 13: No. 4, 555-558(1973).

The survival and level of chromosome aberrations in the bone marrow cells of mice were determined by a metaphase method after whole-body and local irradiation as a function of the dose of ionizing radiation in the control and mexamine-protected animals. The results confirm the presence of a dose dependence of the level of aberrant cells in the case of whole-body and local irradiation and established a correlation between the survival and the number of aberrant cells after whole-body irradiation. The protective effect of mexamine was detected according to the number of aberrant cells and the survival for all the investigated doses of irradiation. (tr-auth)

6993 (AEC-tr-7499, pp 96-102) DISTURBANCE OF TISSUE RESPIRATION AND REACTIVE CHANGES IN THE ULTRASTRUCTURE OF THE MITOCHONDRIA OF INTESTINAL CELLS DURING AMINO ACID TRANSPORT IN IRRADIATED ANIMALS. Strelina, A. V.; Manina, A. A.; Batyuto, T. D. (Central Roentgeno-Radiological Scientific Research Inst., Leningrad). 1973. Translated from Radiobiologiya; 13: No. 4, 559-564(1973).

The transport of a mixture of amino acids is accompanied by a stimulation of respiration and by characteristic changes in the ultrastructure of the mitochondria of intestinal cells of rats. Whole-body x irradiation at a dose of 600 rad influences both indices. Experiments using the uncouplers 2,4-DNP, ADP, and ATP lead to the conclusion that the process of bioenergetics is disturbed in the intestines of irradiated animals, causing a suppression of the function of energy-dependent amino acid transport. (tr-auth)

6994 (AEC-tr-7499, pp 103-110) MODEL OF REPARATIVE REGENERATION IN THE SYSTEM OF CRYPT-VILLUS OF THE EPITHELIUM OF THE SMALL INTESTINE. Tyazhelova, V. G. (Inst. of Biological Physics, Pushchino, USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 565-570(1973).

A model was developed for the reparative regeneration of the crypt-villus system of the intestinal epthelium. The reduction of the number of cells of all types, occurring under irradiation, is a regulatory signal for intensification of proliferation and less intensive desquamation. The passage of cells from one region

into another is hindered immediately after irradiation and occurs when the population of a given region reaches a definite size. On the basis of the agreement with experiments, a type of regulatory feedback among various divisions of the system has been suggested. (tr-auth)

6995 (AEC-tr-7499, pp 111-116) APPROACHES TO MODEL STUDY OF THE DURATION OF HUMAN IRRADIATION IN EXPERIMENTS ON ANIMALS. Koznova, L. B.; Darenskaya, N. G. (Inst. of Biophysics, Moscow). 1973. Translated from Radiobiologiya; 13: No. 4, 571-575(1973).

Two basic approaches to model study of the duration of human irradiation in experiments on animals are discussed. The first of them is based on a knowledge of the differences and peculiarities of the initial physiological parameters of the human organism and animals of different species (in particular, the values of the basal metabolism); the second is based on quantitative differences in the course of recovery processes in the irradiated organism, due to the peculiarities of species reactivity. Calculation data on the duration of irradiation of dogs, rats, and mice, adequate to a 96 hr irradiation of man, are cited. (tr-auth)

6996 (AEC-tr-7499, pp 117-123) SOME PECULIARITIES OF THE ANOMALY OF THE CYCLE OF EXCITABILITY OF THE VISUAL CORTEX IN RABBITS IRRADIATED DURING ORGANOGENESIS. Kolomeitseva, I. A.; Myslobodskii, M. S. (Inst. of Higher Nervous Activity and Neurophysiology, Moscow). 1973. Translated from Radiobiologiya; 13: No. 4, 576-581(1973).

Anomalies of the cycle of recovery of evoked potentials of the visual cortex, expressed in a slowdown of recovery of the primary response and peak-like dynamics of it, are described for animals x-irradiated at a dose of 300 R during the period of organogenesis. An analysis of the pulsed activity of the visual cortex in normal animals and on a model of hypersynchronous activity permitted the suggestion of a relationship of this phenomenon to the intensification of postsynaptic inhibition as a result of release of a hypothetical channel of afferent inhibition. (tr-auth)

6997 (AEC-tr-7499, pp 129-131) INFLUENCE OF LOCAL IRRADIATION OF THE LIVER ON THE ISOENZYME COMPOSITION OF RAT LIVER AND BLOOD SERUM LACTIC DEHYDROGENASE. Kamenets, L. Ya. (Kiev Scientific Research Roentgenoradiological and Oncological Inst.). 1973. Translated from Radiobiologiya; 13: No. 4, 596-598(1973).

The influence of local fractionated irradiation of the region of the liver with x rays (summary dose 4000 R) on the activity of lactic dehydrogenase (LDH) and its individual isoenzymes in the liver and blood serum of rats was studied. A decrease in the total LDH activity was observed both in the liver and in the blood serum. In the liver it was due to a decrease in the activity of the isoenzymes LDH_5 and LDH_4, and in the blood serum LDH_5, LDH_4, and LDH_1. (tr-auth)

6998 (AEC-tr-7499, pp 132-135) CHANGE IN THE ACETYLCHOLINESTERASE ACTIVITY OF WHOLE ERYTHROCYTES DURING RADIATION SICKNESS OF RABBITS. Bondar, A. A. (Leningrad Veterinary Inst.). 1973. Translated from Radiobiologiya; 13: No. 4, 588-591(1973).

The acetylcholinesterase activity of whole erythrocytes (EC 3.1.1.7) was determined, calculated per erythrocyte, during the process of development of radiation sickness in rabbits, x-irradiated at a dose of 800 R. It was shown that together with the quantitative change in the erythrocytes (number and volume), qualitative changes in them arise with respect to acetylcholinesterase activity. (tr-auth)

6999 (AEC-tr-7499, pp 136-140) INFLUENCE OF NONUNIFORM IRRADIATION ON THE DNA CONTENT IN THE RAT INTESTINAL MUCOSA. Libikova, N. I.; Golubentsev, D. A. (Military-Medical Academy, Leningrad). 1973. Translated from Radiobiologiya; 13: No. 4, 592-594(1973).

The changes in the DNA content in the intestinal mucosa were studied at various periods (1, 3, and 5 days) after a single irradiation of the anterior (1700 R) and posterior (1200 R) halves of the body, after repeated (650 R × 4) irradiation of the anterior half of the body, and also after whole-body irradiation (600 R). All the doses of irradiation were equieffective ($LD_{50/30}$). It was shown that the main role in radiation lesion of the intestinal mucosa is played by the direct action of radiation on the gastrointestinal tract, while the remote effect is of secondary importance. (tr-auth)

7000 (AEC-tr-7499, pp 141-145) ANALYSIS OF THE STATE AND REACTIVE PROPERTIES OF THE SYMPATHOADRENAL SYSTEM UNDER CONDITIONS OF TOTAL AND LOCAL IRRADIATION OF RATS. Nuzhnyi, V. P. (First Moscow Medical Inst.). 1973. Translated from Radiobiologiya; 13: No. 4, 595-598(1973).

It was shown that the activation of the hormonal and mediator links of the adrenergic regulation in the case of total irradiation of rats at a dose of 350 rad arises chiefly as a result of irradiation of the body of the animals. The increased sensitivity of the adrenoreactive systems is due primarily to the direct influence of radiation on the central nerve formations. (tr-auth)

7001 (AEC-tr-7499, pp 146-151) BLOOD PLASMA ESTERASES OF TUNDRA VOLES (MICROTUS OECONOMUS), LIVING UNDER CONDITIONS OF AN INCREASED NATURAL RADIATION BACKGROUND. Aliev, A. T.; Kashkin, K. P. (Inst. of Biology, Syktyvkar, USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 598-602(1973).

Four esterase fractions were detected in the blood plasma of young tundra voles of both sexes, living in regions with a low natural radiation background (12 μR/hr) by electrophoresis in agar gel, while five fractions were detected in overwintered animals. Among the blood plasma esterases of the animals, an enzyme that migrates with the mobility of the serum α_1-globulins in electrophoresis dominates. In tundra voles living in regions with an increased natural radiation background (2000 and 4000 μR/hr), changes were noted in the spectrum and activity of the blood plasma esterases, manifested in a decrease in the activity of esterases of the α_1 zone and a sharp increase in the activity of esterases migrating with the serum α_2-globulins. In animals living under conditions of an increased natural radiation background, age variations in the spectrum and activity of the blood plasma esterases are very slight. (tr-auth)

7002 (AEC-tr-7499, pp 152-157) INTENSITY OF THE TURNOVER OF LIPIDS AND PROTEINS OF RAT LIVER MITOCHONDRIA IN THE EARLY PERIODS OF RADIATION SICKNESS. Vinogradova, M. F.; Minyailo, D. D. (Leningrad State Univ.). 1973. Translated from Radiobiologiya; 13: No. 4, 602-606(1973).

An investigation was made of the turnover rate of lipids and proteins of rat liver mitochondria 6, 24, 48, and 72 h after irradiation of the animals at a dose of 800 R. It was established that in the early periods of radiation sickness, an intensification of the turnover of lipids and proteins of the mitochondria is observed, with a maximum after 48 h. After 72 h, at the height of radiation sickness, a decrease in the incorporation of radioactive acetate into the investigated components is noted, especially sharply in the lipids of the mitochondria. (tr-auth)

7003 (AEC-tr-7499, pp 164-168) QUANTITATIVE EVALUATION OF PROTECTION OF THE BONE MARROW OF MICE IN THE CASE OF SEPARATE AND COMBINED USE OF RADIOPROTECTORS. Pugacheva, T. N.; Ovakimov, V. G.; Yarmonenko, S. P. (Inst. of Labor Hygiene and Occupational Diseases, Moscow). 1973. Translated from Radiobiologiya; 13: No. 4, 611-614 (1973).

Under conditions of brief γ irradiation of mice (dose rate 710 R/min), a pronounced radioprotective action of small amounts of AET and cystaphos (25 and 150 mg/kg, respectively) was detected, as was shown earlier for mexamine. A complex of protectors, consisting of 4.3 mg/kg mexamine, 25 mg/kg AET, and 150 mg/kg cystaphos, induces the same effect as the maximally effective amounts of the individual aminothiols and is less toxic than AET and cystaphos. (tr-auth)

7004 (AEC-tr-7499, pp 169-174) AUTOIMMUNE REACTIONS IN MICE AFTER PROLONGED IRRADIATION. Il'in, V. V. (Inst. of Biophysics, Moscow). 1973. Translated from Radiobiologiya; 13: No. 4, 614-618(1973).

In experiments on 1370 noninbred female white mice weighing 18 to 20 g under conditions of prolonged irradiation at doses of 800 to 900 R (dose rate 19 R/h), an increase in the level of normal autoantibodies was noted during irradiation in comparison with irradiation at a dose rate of 392 to 410 R/min. The intensities of the autoimmune response at the height of radiation sickness are lower in the case of prolonged irradiation than in the case of acute irradiation. (tr-auth)

7005 (AEC-tr-7499, pp 175-178) DYNAMICS OF THE CHANGE IN SEROTONIN AND THE NUMBER OF THROMBOCYTES IN THE BLOOD OF RATS DURING THE DEVELOPMENT OF ACUTE RADIATION SICKNESS. Golubentsev, D. A.; Katsev, V. M.; Martirosov, K. S. (Military-Medical Academy, Leningrad). 1973. Translated from Radiobiologiya; 13: No. 4, 619-621(1973).

The changes in the serotonin content and number of thrombocytes in the blood of rats during the development of acute radiation sickness (from the first to the 30th day after whole-body irradiation at a dose of 600 R, $LD_{70/30}$) were studied. On the first days after irradiation and at the height of radiation sickness, a distinct relationship between the change in these indices was detected. At the beginning of the recovery period, a sharp decrease in the serotonin level was detected against a background of a normal

number of thrombocytes. Possible causes and the significance of the changes found in the pathogenesis of radiation hemorrhages are discussed. (tr-auth)

7006 (AEC-tr-7499, pp 179-183) PECULIARITIES OF RADIATION SICKNESS AFTER THE INFLUENCE OF X RADIATION ON THE HEADS OF RATS. Avetison, G. M.; Afrikanova, L. A.; Darenskaya, N. G.; Zaitseva, R. N.; Izmailova, G. M.; Shikhodyrov, V. V. (Inst. of Biophysics, Moscow). 1973. Translated from Radiobiologiya; 13: No. 4, 622-625(1973).

The dose dependence, clinical and morphological peculiarities of the lesion after the influence of 250 kV of x radiation on the rat head in the dose range 1400 to 2000 R are presented. In the clinical picture of the oral syndrome that develops in this case, a leading role is played by radiation lesion of the tongue. (tr-auth)

7007 (AEC-tr-7499, pp 184-189) DETERMINATION OF THE ABSORBED DOSES IN THE TISSUES OF INDIVIDUAL ORGANS OF MICE AND RATS AFTER WHOLE-BODY X IRRADIATION. Pivanova, P. S.; Svetikova, K. M. (Inst. of Experimental Medicine, Leningrad). 1973. Translated from Radiobiologiya; 13: No. 4, 626-629(1973).

A calculation of the integral doses in individual organs of mice and rats, based on data on their topography, weight, and the isodoses of x radiation, is presented. (tr-auth)

7008 (AEC-tr-7499, pp 190-194) INFLUENCE OF GAMMA IRRADIATION AND MERCAMINE ON MOUSE SPERMATOZOA. Mamina, V. P.; Tregubenko, I. P. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). 1973. Translated from Radiobiologiya; 13: No. 4, 630-633(1973).

The morphological and functional changes in the spermatozoa were followed for 120 days on male mice of the BALB line, totally irradiated with γ rays at a dose of 600 R ($LD_{65/30}$). Pronounced changes (with a total loss of mobility) were observed in a population of spermatozoa irradiated at early stages of their differentiation (spermatocytes or spermatogonia). Preliminarily administered mercamine significantly lowered the percentage of anomalous spermatozoa (macrozoospermia). (tr-auth)

7009 (AEC-tr-7534) RADIOBIOLOGY, VOL. 13, NO. 6, 1973. Translation of Radiobiologiya; 13: No. 6, 811-960(1973). 179p. Dep. NTIS $7.60.

Separate abstracts were prepared for the 30 papers presented in this publication. (ERB)

For abstracts of individual papers see: 6835, 6883, 6884, 7010–7035, and 7135.

7010 (AEC-tr-7534, pp 1-3) ROLE OF ENDOGENOUS SUBSTANCES IN THE CREATION OF A BACKGROUND OF INCREASED RADIORESISTANCE. Goncharenko, E. N.; Kudryashov, Yu. B. (Moscow State Univ.). May 1974. Translated from Radiobiologiya; 13: No. 6, 811-812(1973).

The introductory report gives the prerequisites for conducting a series of studies directed toward the investigation of the role of certain endogenous biologically active substances, as well as the mechanism of the action in the radioprotective effect exerted by radioprophylactic agents. (tr-auth)

7011 (AEC-tr-7534, pp 10-16) AMINO ACID COMPOSITION OF BLOOD PLASMA PROTEINS OF ROOT VOLES (MICROTUS OECONOMUS PALL.), LIVING UNDER VARIOUS ECOLOGICAL CONDITIONS. Aliev, A. T.; Korzhuev, P. A. (Inst. of Biology, Syktyvkar, USSR). May 1974. Translated from Radiobiologiya; 13: No. 6, 818-823(1973).

All the amino acids constantly encountered in proteins were detected in the blood plasma proteins of root voles by the method of paper chromatography. The proteins of root voles are characterized by a high content of dicarboxylic amino acids, leucine and isoleucine, lysine, and phenylalanine, and a low content of histidine. No significant deviations from the norm could be established in the percent content of individual amino acids of the total blood plasma proteins of root voles living under conditions of an increased level of natural radiation. (tr-auth)

7012 (AEC-tr-7534, pp 17-24) DYNAMICS OF THE EXCHANGE OF HYDROGEN AND OXYGEN OF THE WATER OF THE ORGANISM OF ORGANIC STRUCTURES OF THE ORGANS AND TISSUES. Shtukkenberg, Yu. M. (Inst. of Biophysics, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 824-829(1973).

The periodic exchange of H and O atoms of the water of the mouse organism with the dry residues of the organs and tissues, occurring with multiple oscillation periods T_k = 2 to 3 days, 2 to 3 and 0.5 hrs, with large amplitudes A_k and low damping, observed only in the living organism, was investigated with the aid of D_2O and $H_2{}^{18}O$. Gamma irradiation at doses up to 1000 R does not change T_k and A_k in the dry residues of the organs and tissues that accelerate the drop in the concentrations of D and ^{18}O in them, slows down the elimination of water from the organism, and increases A_k in the water of the organism. These changes determine the dose and degree of radiation damage. Periodic exchange with T_k = 2 to 3 days for different animals is correlated with the periodicity of the course of radiation damages and the death rate peaks for animals and man. A theoretical explanation is given for the patterns of periodic exchange. (tr-auth)

7013 (AEC-tr-7534, pp 25-29) CYTOFLUORIMETRIC DATA OF A STUDY OF PITUITARY CELLS IN THE CASE OF WHOLE-BODY IRRADIATION. Khamidov, D. Kh.; Khakimov, P. A.; Shaikhov, R. T. (Inst. of Biochemistry, Tashkent). May 1974. Translated from Radiobiologiya; 13: No. 6, 830-833(1973).

The reaction of various types of pituitary cells to radiation influence as a function of the radiation dose and the course of radiation sickness was studied by a cytofluorimetric method. The early response of cells of the pituitary to irradiation at doses of 100, 200, and 400 R is an increase in the amount of DNA, DNP, RNA, and protein, while there is a decrease at doses of 900 and 1200 R. Irradiation at a dose of 400 R causes phase changes in the content of nucleic acids and protein of the pituitary cells. (tr-auth)

7014 (AEC-tr-7534, pp 30-35) RADIOBIOLOGY OF STEM CELLS OF THE INTESTINAL EPITHELIUM. Communication 2. Influence of the Dose Rate of Gamma Irradiation on the Four to Five-Day Death Rate of Mice and Survival of Stem Cells of the Epithelium of the Small Intestine. Konoplyannikov, A. G.; Konoplyannikova, O. A. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). May 1974. Translated from Radiobiologiya; 13: No. 6, 834-838(1973).

A decrease in the dose rate of γ irradiation from 42.50 to 5.46 rad/min leads to an increase in the survival of stem cells of the epithelium of the small intestine and an increase in the values of $LD_{50/4}$ and $LD_{50/5}$ for mice. In this case strict correspondence is observed between the level of intestinal death of the mice and the survival of stem cells of the epithelium of the small intestine. The data were used to evaluate the rate of repair of sublethal radiation damages in the stem cells of the epithelium of the small intestine of mice. A time in which half the sublethal radiation damages that arose are eliminated is approximately 2.8 hrs for the stem cells of the epithelium of the mouse small intestine. (tr-auth)

7015 (AEC-tr-7534, pp 36-42) HISTOLOGICAL ANALYSIS OF ALLOGENIC INHIBITION OF THE ABILITY OF HEMATOGENIC CELLS FOR DIFFERENTIATION AND COLONY FORMATION. Shvets, V. N. (Inst. of Biophysics, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 839-843(1973).

The transplantation of hematogenic cells of mice of the parent lines CBA and C57BL into a hybrid recipient (CBA × C57BL)F_1 leads to inadequate effects. The colony-forming ability and differentiating potentialities of hematogenic cells of CBA mice are manifested uniformly both in the organism of syngenic (CBA) and nonsyngenic (F_1) recipients. For mice of the C57BL line, allogenic inhibition of CFU is observed in the F_1 hybrid. The suppression of colony formation in the spleen of the recipients is accompanied by a change in the direction of differentiation of the remaining CFU. The formation of myeloid colonies in this case is blocked two to three times as strongly as the formation of erythroid-type colonies. The origin of inhibition of CFU in the bone marrow of the recipient is not accompanied by any change in the direction of differentiation of the hematogenic cells of C57BL mice. The ability of bone marrow cells of C57BL mice for colony formation in the F_1 hybrid is inhibited to a substantially greater degree than that of spleen cells. (tr-auth)

7016 (AEC-tr-7534, pp 43-49) STATE OF CELLS OF THE RABBIT MYOCARDIUM AFTER LOCAL IRRADIATION OF THE HEART REGION (CYTOMETRIC ANALYSIS). Vorob'ev, E. I.; Stepanov, R. P. (Central Scientific Research Roentgenoradiological Inst., Leningrad). May 1974. Translated from Radiobiologiya; 13: No. 6, 844-849(1973).

After local irradiation (in doses of 500, 1500, and 2400 rad) thickened muscle cells with enlarged nuclei appear in the heart, the number of which does not decrease during the period of six months. The correlation between the volume of the nuclei and the thickness of the cells is also changed, chiefly in the early periods after irradiation (after 10 days); restoration of these indices occurs to a lesser degree after irradiation at a dose of 2400 rad. A comparison of the indices of the correlation between the thickness of the cells and the volume of their nuclei permits the presence of serious disturbances of the nuclear-cytoplasmic

relationships in the muscle cells of the myocardium after irradiation to be assumed. (tr-auth)

7017 (AEC-tr-7534, pp 50-55) POSTRADIATION CHANGES IN THE REDOX SYSTEMS IN RAT TISSUES. Grozdov, S. P.; Smirnova, T. N.; Kir'yanov, I. Yu. (Inst. of Biophysics, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 850-854 (1973).

The postradiation changes in the redox potential, total content of SH groups, nicotinamide coenzymes, pyruvic and lactic acids in radiosensitive systems are evidence of a limitation of the manifestation of the radiation oxidative effect as a result of inhibition of natural oxidative processes. In the mechanism of the postradiation inhibition of respiration in lymphoid tissues, evidently a significant role is played by the decrease in the SH groups in the nuclei and mitochondria of the cells, as well as the loss of nicotinamide coenzymes. Under conditions of hypoxia, irradiation affects the system of tissue respiration loss, which leads to a more pronounced oxidative effect. (tr-auth)

7018 (AEC-tr-7534, pp 56-60) EFFECTIVENESS OF AUTOLOGOUS BONE MARROW IN DOGS UNDER CONDITIONS OF PROLONGED IRRADIATION WITH A VARIABLE DOSE RATE. Rogozkin, V. D.; Sbitneva, M. F.; Gvozdeva, N. I.; Fedotenkov, A. G.; Shepshelevich, L. L.; Ignasheva, L. P.; Mikhailov, L. M. (Inst. of Biophysics, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 855-858 (1973).

The high effectiveness of automyelotherapy, using both freshly prepared and preserved bone marrow with storage periods from 4 to 14 months, was demonstrated in an experiment on dogs under conditions of 33.5 h γ irradiation with a variable dose rate at a dose of 1000 R (LD_{100}). An earlier recovery of hematogenesis was noted in dogs treated with freshly prepared bone marrow. (tr-auth)

7019 (AEC-tr-7534, pp 61-68) ROLE OF ENDOGENOUS SUBSTANCES IN THE CREATION OF A RESERVE OF INCREASED RADIORESISTANCE. Communication 1. Investigation of the Radioprotective Action of Certain Biogenic Amines on Single Cells and the Simplest Multicellular Organisms. Antonova, S. V.; Berenfel'd, B. S.; Goncharenko, E. N.; Konoshenko, A. I.; Kudryashov, Yu. B.; Svintitskikh, V. A.; Sobolev, A. S. (Moscow State Univ.). May 1974. Translated from Radiobiologiya; 13: No. 6, 859-863 (1973).

Experimental data are presented on the possibility of radioprophylactic protection on single cells. It was shown that erythrocytes, two strains of fungi, as well as yeast cells can be protected from the action of radiation by serotonin, histamine, and dopamine. (tr-auth)

7020 (AEC-tr-7534, pp 69-73) RADIOPROTECTIVE ACTIVITY OF DERIVATIVES OF 2-AMINOTHIAZOLINE. Bogatyrev, G. P.; Lys, Ya. I.; Mal'ko, V. I.; Goncharenko, E. N.; Kudryashov, Yu. B.; Fedoseev, V. M. (Moscow State Univ.). May 1974. Translated from Radiobiologiya; 13: No. 6, 864-867 (1973).

The toxicity, radioprotective effectiveness, and influence of the static redox potential of the mouse femur and spleen of AET, hydrobromides of 2-aminothiazoline (2-AT), some of their derivatives substituted in the 5-position, as well as 2-amino-4-carboxythiazoline, were investigated in experiments on white mice. In the case of intravenous administration to mice 10 min before irradiation with x rays at a dose of 660 R ($LD_{37/30}$), the effectiveness of 2-AT, 2-amino-5-methylthiazoline, and 2-amino-5-hydroxymethylthiazoline is ~80% of the effectiveness of AET. Derivatives of 2-AT (in comparison with AET) have a negligible influence on the level of the redox potential in the tissues of mice; their radioprotective action apparently is not associated with a shift of the redox equilibrium in the organism in the direction of reduced forms. (tr-auth)

7021 (AEC-tr-7534, pp 74-80) LONG-TERM CONSEQUENCES OF WHOLE-BODY AND NONUNIFORM IRRADIATION UNDER CONDITIONS OF THE USE OF A COMPLEX OF RADIOPROTECTORS. Airapetyan, G. M.; Likhachev, Yu. P.; Ivashin, V. A. (Inst. of Labor Hygiene and Occupational Diseases, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 868-873 (1973).

The long-term effects of whole-body and nonuniform (partial) x irradiation under conditions of combined protection and without it were studied on 1260 hybrid mice. A radioprotective effect was achieved with respect to long-term death. It was shown that at certain dose levels, regardless of the volume and localization of the irradiated portion, the final effects may be the same. Cystaphos, mexamine, and AET possessed leukemogenic properties, which are substantially reduced when the animals are irradiated. The general principle is confirmed that large doses reduce the blastomogenesis, while a small nonuniform irradiation promotes the development of tumors of various organs. (tr-auth)

7022 (AEC-tr-7534, pp 88-98) DECREASE IN THE MAMMALIAN MORTALITY FROM THE INTESTINAL SYNDROME BY PARTIAL SHIELDING OF THE HEMATOGENIC SYSTEM OR POSTRADIATION TRANSPLANTATION OF HEMATOGENIC CELLS. Suslikov, V. I. (Inst. of Biophysics, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 880-888 (1973).

On the basis of the hypothesis of the leading specific role of the integration mechanism of radiation death in the general mechanism of the lethal action of radiation on mammals, it is concluded that in the case of shielding of the hematogenic system or postradiation transplantation of hemopoietic cells, a decrease in the mortality of the animals from the intestinal syndrome should be observed; experimental data are cited in confirmation of this conclusion, and possible factors that might be responsible for the absence of this effect in certain studies are analyzed. It is hypothesized that the integration mechanism of radiation death of mammals, formulated in its most general outlines, is of general biological significance as a general mechanism of death in the case of combination of injurious factors of any nature. (tr-auth)

7023 (AEC-tr-7534, pp 99-103) MORPHOFUNCTIONAL STUDY OF THE REPRODUCTIVE ORGANS OF MONKEYS AFTER A SINGLE IRRADIATION. Artembeva, N. S.; Kosichenko, L. I.; Andreeva, A. V.; Zvereva, G. A. (Scientific Research Lab. of Experimental Immunobiology, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 889-892 (1973).

An investigation of 25 monkeys subjected to a single x irradiation at doses of 200 to 755 R and 12 control animals revealed a substantial disruption of the functional activity of the reproductive organs after irradiation, a change in the rhythm of the sex cycles, an earlier onset of menopause, a decrease in the reproductive capacity, and infertility. Irradiation of sexually immature monkeys inhibited the onset of sexual maturity, followed by a disturbance of the rhythm of the sex cycles and a decrease in reproductive capacity. Structural changes in the sex glands, massive atresia of the follicles, disruption of the processes of maturation of the follicles and ovulation, overgrowth of connective tissues, and sclerosing of the organ were detected. (tr-auth)

7024 (AEC-tr-7534, pp 104-109) SELECTION AND ANALYSIS OF PHYSIOLOGICAL INDICES FOR THE PREDICTION OF THE SURVIVAL OF IRRADIATED ANIMALS. Plyushchev, A. K.; Chekhonadskii, N. A.; Makarov, V. P. (Inst. of Biophysics, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 893-897 (1973).

The purpose of this work was to seek a method of predicting the outcome of radiation sickness. Before irradiation, during the immobilization of mice and their placement in a hermetic chamber, seven different physiological indices were recorded. The most informative indices were selected from them by mathematical treatment for a judgment of the reactivity of the animals, and in individual prognosis of survival after irradiation was constructed on the basis of them. The accuracy of the prognosis was 85% in the control experiment. (tr-auth)

7025 (AEC-tr-7534, pp 110-114) STUDY OF tRNA OF THE RAT LIVER AND SPLEEN DURING RADIATION SICKNESS. Chagovets, E. M.; Moskalenko, I. P. (Inst. of Medical Radiology, Kharkov). May 1974. Translated from Radiobiologiya; 13: No. 6, 898-901 (1973).

Lysine, phenylalanine, and valine isoacceptor tRNA, as well as the incorporation of ^{14}C-adenine into the total tRNA of the liver and spleen of normal rats and rats irradiated at a dose of 800 R, were studied on columns of methylated albumin, adsorbed on celite. No changes were observed in the lysine acceptor tRNA's of the liver 24 hr after irradiation; in the case of the lysine and valine tRNA's of the spleen, as well as the phenylalanine tRNA of the liver and spleen, different radiosensitivity of individual isoacceptor tRNA was noted. The biosynthesis of the summary tRNA, studied according to the incorporation of ^{14}C-adenine, is reduced in the spleen and increased in the rat liver 3 and 24 hr after irradiation. (tr-auth)

7026 (AEC-tr-7534, pp 115-120) INFLUENCE OF IRRADIATION ON THE TEMPLATE ACTIVITY OF DEOXYRIBONUCLEOPROTEINS FROM THE RAT LIVER AND SPLEEN. Paskevich, I. F.; Likhoded, V. S.; Fonarev, A. B.; Savenko, L. N.; Ishkhanova, M. A. (Scientific Research Inst. of Medical Radiology, Kharkov). May 1974. Translated from Radiobiologiya; 13: No. 6, 902-905 (1973).

The synthesis of RNA on DNP and DNA isolated from the livers and spleens of irradiated animals (dose 800 R) was studied with the participation of exogenous and endogenous RNA poly-

merases. It was established that RNA synthesis on preparations of DNP from the liver is increased after 24 and 48 hr and is reduced 120 hr after irradiation. In the spleen at all the investigated periods a drop in the template activity of DNP is noted. (tr-auth)

7027 (AEC-tr-7534, pp 121-127) DYNAMICS OF THE CHANGES IN THE ACTIVITY OF CERTAIN ENZYMES OF PROTEIN METABOLISM IN THE SUBCELLULAR FRACTIONS OF THE RABBIT LIVER UNDER THE ACTION OF X IRRADIATION. Savitskii, V. I. (Odessa Medical Inst.). May 1974. Translated from Radiobiologiya; 13: No. 6, 906-910(1973).

The activity of aspartate and alanine aminotransferases and ornithine carbamyltransferase in the mitochondria and hyaloplasm of the rabbit liver was determined, and the direction of changes in the amino acid metabolism in the livers of irradiated rabbits was judged according to these indices. (tr-auth)

7028 (AEC-tr-7534, pp 133-138) VARIATION OF A MATHEMATICAL MODEL OF DAMAGE AND RECOVERY OF INTRACELLULAR MEMBRANE COMPLEXES. Tyazhelova, V. G.; Savel'ev, A. P.; Akoev, I. G. (Inst. of Biological Physics, Pushchino, USSR). May 1974. Translated from Radiobiologiya; 13: No. 6, 913-917(1973).

A variation of mathematical description of radiation damage and recovery of membrane structures of cells, based on the fact that the membranes of the nucleus repair themselves, while membranes of the cytoplasm are also repaired on account of nuclear membranogenesis, is proposed. The model considers the possibility of different thresholds of damages preceding the development of morphologically observed changes and a different rate of damage and recovery of the membrane structures. Model study on an electronic computer was conducted. (tr-auth)

7029 (AEC-tr-7534, pp 143-146) THERAPEUTIC ACTIVITY OF PROTEIN FRACTIONS OF HETEROLOGOUS SERUM DURING ACUTE RADIATION SICKNESS. Ivanov, A. A.; Nevinnaya, A. P. (Inst. of Biophysics, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 920-922(1973).

The protein fractions of normal rabbit serum obtained by gel filtration, with an amount of protein corresponding to the content in 1 ml of serum, in the case of intraperitoneal administration to guinea pigs irradiated at a dose of 450 R, had a pronounced therapeutic effect. The most active was fraction II, with sedimentation coefficient 7S: the 30-day survival was 86.6%, as against 26.5% in the control group. (tr-auth)

7030 (AEC-tr-7534, pp 147-150) INFLUENCE OF SERUM PROTEIN FRACTIONS OBTAINED FROM IMMUNIZED AND INTACT ANIMALS ON THE OUTCOME OF RADIATION SICKNESS IN RATS. Grishchenko, A. M. (Scientific Research Roentgenoradiological and Oncological Inst., Kiev). May 1974. Translated from Radiobiologiya; 13: No. 6, 923-925(1973).

The immunization of rats with a corpuscular antityphoid vaccine significantly increases the absolute amount of protein in the blood serum on account of all three fractions of serum proteins isolatable by gel filtration through Sephadex G-200, with a predominance of the first and second fractions. A single intravenous injection of the first fraction of serum proteins obtained from immunized and intact animals and of the second fraction of proteins obtained from immunized rats of the Wistar line, immediately after irradiation ($LD_{50/30}$) of nonimmunized rats, significantly increases the postradiation survival of the animals. (tr-auth)

7031 (AEC-tr-7534, pp 151-155) INCREASE IN TISSUE RESPIRATION AS THE CAUSE OF THE DECREASE IN THE OXYGEN TENSION IN TISSUES BY RADIOPROTECTIVE SYMPATHICOMIMETICS. Zolochevskaya, L. I. (Ukrainian Inst. for the Advanced Training of Physicians, Kharkov). May 1974. Translated from Radiobiologiya; 13: No. 6, 926-929(1973).

The introduction of radioprotective doses of adrenalin and isadrine increases the absorption of oxygen by mouse liver and spleen slices. This effect is absent for noradrenalin and mesatone. The negative correlation of the effects of radioprotective sympathicomimetics on the absorption and tension (pO_2) of oxygen in the spleen shows that the cause of the change in pO_2 is an increase in the utilization of oxygen for oxidative processes. (tr-auth)

7032 (AEC-tr-7534, pp 156-160) QUANTITATIVE ANALYSIS OF THE PROTECTIVE EFFECT OF AET FROM SYSTEMIC RADIATION LESIONS. Aizina, N. L.; Ovakimov, V. G.; Yarmonenko, S. P. (Inst. of Experimental and Clinical Oncology, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 929-933(1973).

The radioprotective action of AET on the survival of mice, the change in the number of CFU and the number of nucleated bone marrow cells were studied. It was shown that there is a positive correlation between the quantitative indices of the state of the system of hematogenesis and the probability of death of the animals. It was suggested that the degree of correlation depends on the mechanism of the protective action of the protectors, in particular, on how effectively they protect one vitally important system or the organism of another. (tr-auth)

7033 (AEC-tr-7534, pp 161-166) INFLUENCE OF A COMBINATION OF CYSTAPHOS-MEXAMINE ON CERTAIN CHANGES IN THE HEMOPOIETIC SYSTEM AFTER REPEATED IRRADIATION. Kavukchyan, T. V.; Bogatyrev, A. V.; Nikanorova, N. G.; Sverdlov, A. G. (Inst. of Nuclear Physics, Leningrad). May 1974. Translated from Radiobiologiya; 13: No. 6, 933-937(1973).

The influence of mexamine in conjunction with cystaphos in the change in the number of bone marrow karyocytes and the colony-forming ability of the stem cells of mice under conditions of three to five x irradiations at a dose of 400 R at intervals of from two to 10 days was investigated. The joint administration of these radioprotectors provides for protection of the bone marrow under these conditions of irradiation. Possible mechanisms of protection are discussed. (tr-auth)

7034 (AEC-tr-7534, pp 167-171) RADIOPROTECTIVE ACTION OF COMPOUNDS OF VARIOUS CLASSES AND THEIR INFLUENCE ON THE REDOX POTENTIAL OF MUSCLE TISSUE. Parfenov, A. I.; Yusipov, V. S.; Strel'nikov, Yu. E.; Nenarokova, L. I. (Military-Medical Academy, Leningrad). May 1974. Translated from Radiobiologiya; 13: No. 6, 938-941(1973).

In a comparison of the radioprotective action of 70 chemical substances from different classes with their influence on the level of the redox potential in the muscle tissue of mice, it was established that a correlation between the radioprotective activity and the degree of reduction of the redox potential is characteristic of only some of the compounds. (tr-auth)

7035 (AEC-tr-7534, pp 172-176) PREDICTION OF THE RADIOBIOLOGICAL EFFECT OF PHARMACOLOGICAL PROTECTION UNDER CONDITIONS OF NONUNIFORM IRRADIATION (SHIELDING OF THE ABDOMINAL REGION). Davydov, B. I. May 1974. Translated from Radiobiologiya; 13: No. 6, 941-944 (1973).

An equation is proposed for the pharmacological protection under conditions of shielding of the abdominal region [$P_{S_x}(D)$]: $P_{S_x}(D) = P_{S_2}(D_{eff}) = P_{S_2}(D) + P_{S_1}(D) - P_{S_0}(D)$ or $P_{S_x}(D) = (a_1 + a_2 - a_0 - \log D)/b$, where $P_{S_{0,1,2}}(D)$ is the survival in probits without protection, with local and pharmacochemical protection, respectively; a_0, a_1, a_2, and b are coefficients; D is the dose of whole-body irradiation, R. A particular case was considered for rats: shielding of 25% of the volume of the abdominal region, residual dose behind the screen, 40%, radioprotector used cystamine dihydrochloride. Good agreement of the predicted survival with the experimental data was obtained. (tr-auth)

7036 (CONF-700681-) MATERIALS OF THE FIRST ALL UNION CONFERENCE, PHARMACOLOGY OF ANTIRADIATION PREPARATIONS, 2-5 JUNE 1970, MOSCOW. Zherebchenko, P. G.; Chernov, G. A.; Kalistratov, G. V.; Romanov, A. I. (eds.). (Institut Biofiziki, Moscow (USSR)). 1970. Translated by Williams J. Grimes from Institute of Biophysics, Ministry of Health of the USSR, Moscow. 119p. Dep. NTIS $5.45.

Separate abstracts were prepared for the 44 papers presented in these proceedings. (ERB)

For abstracts of individual papers see: 6897-6899, and 7037-7077.

7037 (CONF-700681-, pp 1-3) PHARMACOLOGY AND TOXICOLOGY OF MEXAMINE. Mashkovskii, M. D.; Arutyunyan, G. S.; Roshchina, L. F. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The substance 5-methoxytryptamine, a close analog and one of the possible metabolites of serotonin (5-oxytryptamine), exhibits pronounced pharmacological activity. A pharmacological study of the hydrochloride of 5-methoxytryptamine (mexamine) shows that this compound has an active influence on various functions of the organism. Mexamine resembles serotonin in a number of its pharmacological parameters, but there are both quantitative and qualitative differences in the effect of these two compounds. (ERB)

7038 (CONF-700681-, pp 4-6) TOLERANCE TO RADIOPROTECTIVE COMPOUNDS AFTER REPEATED ADMINISTRATION. Shashkov, V. S.; Anisimov, B. V.; Novikova, S. P. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

In the present study, under standard experimental conditions, the tolerance of various radioprotectors given repeatedly was studied. The experiments were performed on non-pedigreed male mice weighing an average of 20 to 22 g. The radioprotectors were dissolved in physiological solution and administered intraperitoneally two to six times at intervals of 15 min in a volume of 0.2 ml. The tolerance of mice to the administration of serotonin, mexamine, AET, cystamine, and cystaphos was studied. In addition, the change in sensitivity of mice to the repeated administration of serotonin and mexamine was studied following preliminary treatment with reserpine, which provokes secretion of endogenic serotonin from the tissue reserve. In this series of experiments, reserpine was given intraperitoneally in doses of 40 and 4 mg/kg eighteen hours prior to the first injection of serotonin or mexamine. The mice were kept under observation for two weeks following administration of the radioprotectors. (ERB)

7039 (CONF-700681-, pp 7-9) PHARMACOLOGICAL PROPERTIES OF TRYPTAMINE DERIVATIVES. Mashkovskii, M. D.; Trubitsyna, T. K. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Interest in tryptamine as a biogenic amine and a substance with a pronounced pharmacological activity, as well as data on the pharmacological activity of certain of its derivatives (serotonin, etc.) provided a basis for further investigations of this series of compounds. Studies were made on analogs of tryptamine, substituted at the alpha- and beta-positions of the side chains (Group I); homologs of tryptamine with a lengthened alkyl chain, substituted and unsubstituted at the nitrogen atom in the side chain (Group II). (ERB)

7040 (CONF-700681-, pp 10-12) PHARMACOLOGICAL PROPERTIES OF MEXAMINE ADMINISTERED TO DOGS IN DIFFERENT WAYS. Shashkov, V. S.; Anisimov, B. V.; Novikova, F. P.; Tkachenko, P. A. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Mexamine was introduced into the stomach through the fistula in a dose of 100 mg/kg, dissolved in 20 ml of physiological solution. In a second series of experiments, the mexamine (10 mg/kg) was given intramuscularly. In one case, the fistula was found to be blocked, and the preparation was given to the dog with its food, at a dose of 100 mg/kg. Two to three minutes after administration of the mexamine, the dogs became extremely excited, pulled free of the holders, and whined. Excessive salivation was observed. The animals licked their chops continuously, and sometimes displayed an inclination toward vomiting. As a rule, the animals calmed down after thirty to thirty-five minutes, sometimes lay down and dozed. Forty-five to fifty-five minutes after administration of mexamine lacrimation and excessive secretion from the nose was observed. Toward the end of the experiments, the animals' behavior was completely normal. The experiments showed that the nature of the influence of mexamine on respiration and blood pressure of unanesthetized dogs is independent of the methods of administration of the preparation. Certain changes were observed, but they mostly involved only the duration of the effect produced by mexamine. (ERB)

7041 (CONF-700681-, pp 13-14) PHARMACOLOGICAL PROPERTIES OF SEROTONIN ADIPINATE AND OTHER ORGANIC SALTS OF 5-OXYTRYPTAMINE. Mashkovskii, M. D.; Suvorov, N. N.; Kaminka, M. E.; Morozovskaya, L. M.; Sorokina, N. P.; Tsvetkova, G. N. 1970. Translated from Materials of the First All-Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

In seeking new salts of serotonin that are more readily available and exhibit improved physical and chemical characteristics, a pharmacological series of new salts of 5-oxytryptamine, serotonin maleate, serotonin succinate, and serotonin adipinate, were obtained and studied. The method of obtaining them consists in the reaction of a 5-oxytryptamine base in alcohol with appropriate dibasic organic acids (maleic, succinic, adipinic). The pharmacological action of the new salts was studied in comparison with serotonin creatinine-sulfate on the basis of a number of parameters characteristic of 5-oxytryptamine. The following parameters were studied: the spasmogenic effect on isolated horns of the uterus of the rat; influence on the vessels of isolated rabbit ears; the bronchial musculature, arterial pressure, respiration, tonus of the third eyelid of anesthetized cats; the hypertensive effect in dogs against a background of blockade of ganglia; the influence on plethora of the spleen and kidneys (method of oncography) in the cat. In experiments on rats the influence of the preparations on vascular permeability was compared (on the basis of tissue edema). (ERB)

7042 (CONF-700681-, pp 15-16) COMPARATIVE EFFECTS OF MEXAMINE AND SEROTONIN ON THE CIRCULATION IN THE BRAIN. Mashkovskii, M. D.; Lanskii, V. P. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The influence of mexamine and serotonin on various indices of blood circulation in the brain in anesthetized cats and dogs was studied. The volume rate of blood flow in the tissues of the cortex of the parietal and occipital lobes, as well as in the reticular formation of the brain (in the region of the n. reticularis tegmentalis) was determined by the thermoelectric method (M. Ye. Marshak, 1963). The oxygen tension (pO_2) in the tissues of these areas was recorded by the method of polarography (Kater et al., 1959). The tonus of the brain vessels was studied by means of perfusion techniques (V. M. Khayutin et al., 1958). In addition, the venous outflow from the upper sagittal sinus was studied using the method of Ingvar and Soderberg (1956), as well as the arterio-venous oxygen differential by the method of oxyhemometry (Ye. M. Kreps, 1959). In all the experiments the systemic arterial pressure in the femoral artery was recorded by means of a mercury manometer. The studies revealed that mexamine and serotonin are similar in their effect on the blood circulation in the brain and the systemic arterial pressure. The intravenous administration of mexamine in doses of 25 to 100 μg/kg was accompanied by an attenuation of blood circulation in the investigated areas of the brain. The systemic arterial pressure decreased at the same time. In some experiments, simultaneously with the pressor reaction of the arterial pressure, a slight increase in blood circulation in the brain was observed. The administration of serotonin under these conditions produced only a drop in the arterial pressure and an attenuation of the blood circulation in the brain. (ERB)

7043 (CONF-700681-, pp 17-18) PHARMACOLOGICAL PROPERTIES OF AMINOTHIOL RADIOPROTECTIVE COMPOUNDS. Ovakimov, V. G.; Rogozkin, V. D.; Tarasenko, A. T.; Khmel'kova, N. V.; Ayrapetyan, G. M. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

A comparative investigation of the pharmacodynamic properties of MEA bitartrate, MEA hydrochloride, and cystamine was conducted. The LD_{50} of MEA bitartrate for peroral administration to mice is 3,600, for MEA hydrochloride— 1,100, and cystamine— 1,900 mg/kg. The LD_{50} of MEA bitartrate for intraperitoneal administration is 1,300, for hydrochloride— 540, and cystamine— 433 mg/kg. The maximum tolerable and minimum lethal doses of MEA bitartrate for intravenous administration to dogs are 250 and 300 mg/kg, respectively. In experiments involving the recording of arterial pressure in rats when the latter are given thiol compounds in radioprotective doses, and also in experiments with perfusion of isolated rabbit ears and isolated sections of the small intestine, the state of the adreno-M- and N-cholino- serotonino- and histaminosensitive receptors was studied. (ERB)

7044 (CONF-700681-, pp 19-20) PHARMACOLOGICAL EFFECTS OF MEXAMINE AND S-β-AMINOETHYLISOTHIORONIUM IN COMBINATION WITH OTHER SUBSTANCES. Shashkov, V. S.; Pykhtina, A. A.; Ziya, A. V. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The toxicity, influence on circulation, and diuresis of mexamine, AET, and several combinations of them were studied. The experiments were performed on white mice and rats. In the mice, the toxicity was determined by internal administration and intraperitoneal administration, while in the rats it was intraperitoneal alone. The toxicity was evaluated on the basis of the LD_{50}, LD_{16}, and LD_{84} values, calculated according to Litchfield and Wilcoxon. In the experiments with mice, toxicity was determined for mexamine, a combination of mexamine and phenamine (2 mg/kg), strychnine nitrate (0.1 mg/kg), aminazine (1 mg/kg), ascorbic acid (200 mg/kg); a combination of mexamine with the same pharmacological substances but without aminazine; mexamine with simultaneous or preliminary administration of aminazine. In addition, the toxicity of mexamine previously labeled with

urethane (1 g/kg) was tested in rats. Simultaneous administration internally and intraperitoneally of mexamine to mice with phenamine, strychnine nitrate, aminazine and ascorbic acid produced practically no change in the toxicity of the radioprotector. If aminazine is excluded from this group, the toxicity of the mexamine decreases. Simultaneous or preliminary (30 minutes prior to administration of mexamine) use of aminazine causes an increase in the toxicity of this radioprotector. (ERB)

7045 (CONF-700681-, pp 21-23) OXYGEN TENSION IN THE SUBCUTANEOUS TISSUE OF DOGS: EFFECTS OF DIFFERENT METHODS OF ADMINISTRATION OF MEXAMINE. Rampan, Yu. I.; Yarmonenko, S. P.; Mashkovskii, M. D.; Arutyunyan, G. S.; Osipov, N. E. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

In order to obtain data on the influence of mexamine on oxygen tension (pO_2) in the tissues of dogs, it was necessary to determine the degree of decrease of pO_2 under the influence of tolerated doses of mexamine administered internally and intramuscularly, to determine the effectiveness of the preparation depending on the medicinal form, and also to obtain data on the individual sensitivity of the dogs to mexamine. Twenty-two dogs were used in the experiments. When administered intramuscularly at a dose of 9 mg/kg, mexamine reduced pO_2 in the subcutaneous cell structure by 30% and produced only a slight reddening of the sclera in the dogs. At a dose of 50 mg/kg, the mexamine reduced pO_2 by 75%. This dose obviously was close to the maximum tolerable dose. When mexamine was administered in gelatin capsules, a dose of 50 mg/kg was ineffective. The decrease in pO_2 (by 30% at the maximum) took place only after administration of 100 and 150 mg/kg. There was a reliable difference only during the periods when the pO_2 began to drop, and these intervals occurred earlier at lower doses of the preparation. When a certain dose of mexamine was given in capsules or in solution, the decrease of pO_2 in the latter case was more pronounced: it began earlier, reached a maximum value sooner, and the latter situation was itself more evident. At a dose of 150 mg/kg, given in the form of a solution and in capsules, the maximum decrease in pO_2 was 60 and 30%, respectively. When mexamine was used in solution (150 mg/kg) the principal decrease in pO_2 took place during the first six minutes (up to 58%). Then, during the next twenty-four minutes, it decreased comparatively slightly (to 41%), and thirty minutes after administration of the preparation the pO_2 in the skin had already begun to recover. (ERB)

7046 (CONF-700681-, pp 24-26) INFLUENCE OF CYSTAMINE ON THE FUNCTIONAL STATE OF THE GASTROINTESTINAL TRACT OF HEALTHY AND IRRADIATED RATS. Krasnykh, I. G.; Razgovorov, B. L.; Tyutin, L. A. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

A comparative study of the influence of the optimally protective doses of cystamine on the functional condition of the gastrointestinal tract of healthy and irradiated experimental animals was conducted. The experiments were performed on 80 rats, divided into four groups. Group 1 consisted of ten healthy rats (controls). Group 2 consisted of twenty rats, which received interperitoneally a dose of 1% solution of cystamine (100 mg/kg). Group 3 rats (30 animals) was subjected to gamma radiation alone on the "Khizatron" apparatus at a dose of 840 R (dose intensity 11.7 r/min, skin-focus distance 100 cm) without chemical protection. The animals in group 4, ten to fifteen minutes prior to irradiation administered under the same conditions, received cystamine intraperitoneally at the rate of 100 mg/kg. The material indicates that the administration of cystamine to healthy rats produces functional changes in the stomach and intestine that depend on the dose of the preparation. Prophylactic injection of cystamine to animals prior to irradiation reinforces the spasms of the pylorus and prepyloric portion of the stomach during the first few hours and also retards the evacuation of barium. However, later on the cystamine has a pronounced normalizing action on the gastrointestinal tract during the entire observation period. (ERB)

7047 (CONF-700681-, pp 27-28) INFLUENCE OF MEXAMINE, S-β-AMINOETHYLISOTHIORONIUM, AND COMBINATIONS OF THE ABOVE ON THE FUNCTION OF THE CORTICAL AND MEDULLARY LAYERS OF THE ADRENALS. Pykhtina, A. A.; Bolotskaya, S. A.; Ziya, A. V. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The functional activity of the cortical and medullary layers of the adrenals under the influence of mexamine, S-β-aminoethylisothioronium (AET), and certain combinations of these two substances was studied. The experiments were performed on white rats of both sexes. The function of the adrenal cortex was evaluated on the basis of the content of ascorbic acid. One hour following intraperitoneal administration of mexamine and a combination of mexamine with AET there was a pronounced drop in the level of ascorbic acid in the adrenals, spleen, and liver, indicating an increase in the functional activity of the adrenal cortex. At the same time, the stimulating effect of AET on the adrenal cortex was evident to a very slight degree. Mexamine, given to the animals with strychnine nitrate, phenamine, aminazine, and ascorbic acid, did not change the function of the adrenal cortex. However, following joint application of mexamine, AET and the above preparations, a stimulating effect on the function of the adrenals was observed. Hence, when mexamine is combined with the above preparations, its activating influence on the adrenal cortex is reduced. However, the simultaneous administration of the pharmacological substances we used together with two radioprotectors (mexamine and AET) did not reduce the stimulatory influence of the latter on the adrenal cortex. (ERB)

7048 (CONF-700681-, pp 29-30) EFFECTS OF MEXAMINE ON CORTICOSTERIOD METABOLISM. Shapiro, G. A.; Chernov, G. A.; Vernigorova, L. A.; Atamanova, O. M.; Romanov, A. I. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

In experiments on mice and dogs, the influence of mexamine on the content of 11-oxycorticosteroids (11-OCS) in the blood was studied. Mexamine was given to the dogs intramuscularly at a dose of 20 mg/kg, while the mice received 5 to 50 mg/kg intravenously. Data indicated that mexamine causes a rise in the level of 11-OCS in the blood of animals of both species, but the increase in the content of these hormones was much higher in mice than in dogs. In the latter, regardless of the pronounced clinical reaction, only a moderate increase in the level of 11-OCS in the blood was recorded. (ERB)

7049 (CONF-700681-, pp 31-33) EFFECTS OF MEXAMINE AND MERCAMINE ON DIURESIS. Arzamastsev, E. V.; Frigidova, L. M. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The antidiuretic effect of antiradiation preparations: mexamine and mercamine was studied in male Wiston rats. Following the administration of mexamine (0.5 mg/kg, subcutaneously), the diuresis curve showed no significant change; excretion of urine, as in the controls, took place essentially during one to two hours and terminated by the end of the fourth or fifth hour. However, the quantity of urine, in comparison with the controls, decreased by 20%. As the mexamine dose rose to 7.5 mg/kg, the antidiuretic effect became more marked. With further increases in the dose of mexamine (20.0 mg/kg, intraperitoneally), a still greater disruption of the functional state of the kidneys was observed. Study of the antidiuretic effect of mercamine revealed that when it is given in a dose of 10.0 mg/kg intraperitoneally the diuresis curve does not change significantly; urine excretion, as in the controls, occurs during the first two hours, dropping to 3 to 5% by the end of the fourth to fifth hours. Total diuresis for five hours also does not differ markedly from diuresis in the control group. Mercamine, given in a radioprotective dose of 100.0 mg/kg, causes anuria in the first hour. In following hours, the inhibiting effect of mercamine on diuresis gradually dies out and urine excretion rises, reaching a maximum in five hours. However, the total diuresis in five hours is markedly less than similar parameters in the control group ($p < 0.001$). (ERB)

7050 (CONF-700681-, pp 34-35) EFFECTS OF CYSTAMINE, AET, AND 5-METHOXYTRYPTAMINE ON BLOOD COAGULATION IN RATS. Anashkin, A. D.; Shashkov, V. S. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From first all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The influence of cystamine, AET, and mexamine on the coagulation of blood in healthy rats was studied. Thirty minutes after intraperitoneal injection of cystamine and AET in doses of 75 mg/kg and mexamine in a dose of 25 mg/kg, there was a sharp

rise in the coagulation ability of the blood, which is associated with an increased formation of thromboplastin. (ERB)

7051 (CONF-700681-, pp 36-38) EFFECTS OF CYSTAPHOS (MONOSODIUM SALT OF β-AMINOETHYLTHIOPHOSPHORIC ACID) ON KIDNEY FUNCTION. Kukushkin, A. V. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 Jun 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The influence of cystaphos on kidney function was studied in ten female dogs one and a half and six and a half hours following its intravenous administration at a dose of 100 mg/kg (43 mg/kg using cysteamine as the basis). Each animal received two injections of the substance (a total of twenty experiments in all). Following administration of the cystaphos, a sharp antidiuretic effect was observed. One and a half hours after administration of the preparation, diuresis fell by 1.31 ± 0.6 ml/min ($p < 0.001$) and amounted to 9.5 - 36.8% of the original average values. Six and a half hours after injection of cystaphos, the drop in diuresis was also significant, but slightly less than after one and a half hours. Cystaphos produced a significant drop in renal blood flow and plasma flow after one and a half hours, but after six and a half hours renal hemodynamics had returned to normal, and the decrease in blood flow was slightly less than for plasma flow. (ERB)

7052 (CONF-700681-, pp 39-40) EFFECTS OF MEXAMINE, AET, AND CYSTAMINE ON ELECTROLYTE BALANCE OF RATS. Osipov, Yu. Yu.; Shashkov, V. S. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Male Wistar rats received intraperitoneal injections of mexamine (25 mg/kg), AET (75 mg/kg), or cystamine (75 mg/kg) and thirty minutes later the water, sodium, and potassium contents and the hematocrit of whole blood were determined. The changes observed in the water-salt status of the organism under the influence of the administered substances were dependent in their influence on the permeability of the histohematic barriers. (ERB)

7053 (CONF-700681-, pp 41-42) ANTIEMETIC PROPERTIES OF DERIVATIVES OF TETRAHYDRO-γ-CARBOLIN. Verkhovskii, Yu. G.; Il'yuchenok, T. Yu.; Shadurskii, K. S. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Proceeding from the fact that the antihistaminic preparations have an antiemetic effect, studies were undertaken to ascertain the antiemetic properties of the derivatives of tetrahydro-γ-carbolin, which display considerable antihistaminic activity and are also free of the other effects that are displayed by derivatives of phenothiazine. Four compounds were studied: 9-[2-(2-methylpyridyl-5)-ethyl]-3-ethyl-1, 2, 3, 4-tetrahydro-γ-carbolin (1); 9-[2-(2-methyl-pyridyl-5)-ethyl]-3-butyl-1, 2, 3, 4-tetrahydro-γ-carbolin (2); dimebol (3) and etkalino (4). Observations showed that the tested derivatives of γ-carboline (5% of MLD) did not prevent vomiting caused by apomorphine in dogs in large doses (0.4, 0.5, and 0.6 mg/kg), but its intensity decreased. (ERB)

7054 (CONF-700681-, pp 43-45) INFLUENCE OF DIMEKARBINE ON THE ARTERIAL PRESSURE AND MORPHOLOGICAL COMPOSITION OF THE BLOOD OF IRRADIATED RABBITS. Il'yuchenok, T. Yu.; Lepekhin, V. P.; Shadurskii, K. S. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The experiments were performed on fifty-seven male chinchilla rabbits weighing 2.4 to 2.5 kg. The blood pressure was recorded by the Grant-Rotschild method using the ear artery. After the background was established (blood pressure, blood indices), the animals were exposed to general external x-radiation (spheroterix) in doses of 900 and 1,000 r at an intensity of 70 r/min and 600 R at an intensity of 7.5 r/min. Two hours after irradiation, twenty-five rabbits were given dimekarbine once a day for fifteen days (1,2-dimethyl-3-carbetoxy-5-oxyindole) with the food at the rate of 10 mg/kg. Thirty-two rabbits served as controls. On the second day following irradiation with 900 R (70 r/min), all seventeen rabbits developed a significant decrease in blood pressure. On the fourth and eighth days maximum hypotension (91.1 ± 3.9 mm Hg) was observed. Recovery was slow and the original level of 103.3 (115.4 to 91.2) was reached on the eighteenth to twentieth days. The number of leucocytes on the third day was 3,700 per mm^3 of blood while on the sixth day it was 600. On the days that followed, there was a slow recovery of the blood pressure, but the initial level was not reached. The number of erythrocytes on the third, eighth, and fifteenth days of the experiment decreased to 3.6 million cells per mm^3 and remained at this level until the twenty-first day. The hemoglobin content dropped (49 to 45%) from the thirteenth until the nineteenth days. Recovery of the erythrocyte and hemoglobin indices took place on the thirty-fifth and thirty-sixth days, respectively. Four rabbits out of seventeen remained alive. The average survival time of the animals that died was 4.6 ± 1.03 days. With irradiation at a dose of 1,000 R, (70 r/min), the blood pressure in the animals (five rabbits) dropped after the second day, reaching a maximum on the third day, after which it returned to normal. On the sixth day a severe hypotension developed and all the animals died. Beginning on the second day, there was also a sharp drop in the number of leucocytes (500 cells/mm^3), erythrocytes and the percentile content of hemoglobin. On the fifth day, the number of leucocytes was 1,000 cells/mm^3, and there was a slight increase in the indices of the erythrocytes and the hemoglobin. (ERB)

7055 (CONF-700681-, pp 46-48) SIGNIFICANCE OF ALLERGIC REACTIONS IN THE MECHANISM OF THE TOXIC ACTION OF RADIOPROTECTIVE COMPOUNDS ON MAMMALS. Klemparskaya, N. N. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

In order to select the most effective protectors, a simple test whose effectiveness for these purposes has been demonstrated by a number of experimental papers is recommended. Such a test is the subcutaneous administration of sterile distilled water into the skin of the upper lip of a white mouse on the third day following irradiation with gamma rays from cobalt ^{60}Co at a dose of LD_{75-100} = a labial reaction. The osmotic trauma produced by the injection of the water leads to the formation of tissue products of cellular decay that act as a discriminating factor against the background of radiation autoallergy. After one to three days, a hyperergic hemorrhagic reaction developed at the point of injection. The test is technically simple and cheap, since only eight to ten mice are needed for testing each preparation and it gives clear and very indicative results in a short period of time (seven to ten days). Evaluation of the effectiveness of the protectors by ordinary methods (survival time of irradiated protected animals) is much more costly, since it takes a long time (thirty days) and twenty to thirty mice have to be used. It was found that all the protectors (of different types), which are effective with respect to protection against radiation sickness, and the widely used preparations of antibiotics will completely prevent the development of labial reactions, i.e., they reduce the formation of the autoimmunogenic process. (ERB)

7056 (CONF-700681-, pp 49-51) PHARMACOLOGICAL PROPERTIES OF SEVERAL METABOLITES OF AMINOTHIOLS. Zherebchenko, P. G.; Tank, L. I.; Pushtoshkin, G. I.; Slavachevskaya, N. M. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

As the possible metabolites of aminothiols, their primary products of oxidation (cystamine sulfon, N, N^1-tetramethylcystamine sulfon, S- and N-acetylcysteamine) were synthesized as well as the products of a more extensive conversion of these compounds (hypotaurine, taurine and thiotaurine). The study was performed on white non-pedigreed mice of both sexes and on white rats. The preparations were administered to the animals in equimolar doses. The doses of aminodisulfides and their sulfons were calculated on the basis of the millimole of the compound that was formed in the organism upon breakage of the disulfide bond. Toxicity was determined by the intraperitoneal and subdural methods of administering preparations. The radioprotective effect was studied under conditions of gamma irradiation at a dose of 750 r at the rate of 160 r/min. The preparations were administered intraperitoneally thirty minutes prior to irradiation. Among the side effects, the antidiuretic effect and the inhibition of the evacuatory function of the stomach were studied. Diuresis was determined after a water load. The evacuatory ability of the stomach was evaluated on the basis of the amount of liquid content in it following peroral administration of 0.8 ml of water to the mice. (ERB)

7057 (CONF-700681-, pp 52-54) METABOLISM IN RATS AND DOGS OF RADIOPROTECTIVE COMPOUNDS CONTAINING SULFUR. Titov, A. V.; Golubentsev, D. A.; Kukushkin, A. V.; Merkin, T. N.; Mordukhovich, V. V. 1970. Translated from

Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

A comparison of the excretion of thiols upon injection of SP (protectors containing sulfur) in different species of animals indicates the existence of certain species differences. In rats, when MEA and cystaphos are used in equimolar doses (2 millimoles/kg, intravenously), the same quantity of protector is excreted with the urine (15 to 17% of the administered dose). In dogs, there are greater differences in the excretion of thiol with injection of the above compounds. These differences are particularly clearly evident thirty minutes after the application of each protector, i.e., during the period of development of an acute protective effect. When cystaphos and cystamine are used (0.56 millimoles/kg based on potential thiol, intravenously) seventeen and 0.5% of the administered dose, respectively, is excreted with the urine. In urine collected 6.5 hours later, we found 32% of the administered dose of cystaphos; a similar value for cystamine was only 10%. At later stages following administration of each of these protectors to dogs, their excretion in the urine was not observed. The results of the experiments showed that thirty minutes after administration of cystaphos the urine excreted by the dogs mainly contains nonhydrolyzed molecules of this compound, while at later stages it is primarily MEA and cystamine that are excreted. The urine of rats which have received injections of cystaphos shows only MEA and cystamine. Obviously, hydrolysis of cystaphos takes place very rapidly in the organism of the rats and slowly in the dogs. Clear differences in the metabolism of sulfur-containing protectors in rats and dogs were shown. These differences showed up primarily in the nonuniform distribution of the protector in the organism of the animals of different species and its excretion in the urine. From the standpoint of radioprotective effects, the accumulation of cystamine in much higher concentrations in such radiosensitive tissues of large laboratory animals as the small intestine and spleen is of considerable importance. (ERB)

7058 (CONF-700681-, pp 55-57) EFFECTS OF HISTAMINE IN THE TOXIC AND RADIOPROTECTIVE EFFECT OF 5-METHOXYTRYPTAMINE AND SEVERAL RADIOPROTECTORS CONTAINING SULFUR. Zherebchenko, P. G.; Zaytseva, T. G. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference, pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Using experiments on mice and rats, the influence of histamine and antihistaminic preparations on the toxicity and the effect of the latter on the antiradiation activity of 5-methoxytryptamine (5-MOT), cystaphos (TsF), and cystamine (C) were studied. Under the influence of radioprotectors, comparatively small amounts of histamine are liberated, so that in experiments on mice in combination with the radioprotectors the substance was used at a dose of 9 mg/kg. This is only slightly higher than 1% of its average lethal dose. The toxicity of TsF combined with histamine was insignificantly increased. A pronounced intensification of the toxic effect of 5-MOT by histamine was observed. The average lethal dose of the latter in experiments on mice with separate intraperitoneal injection was 214 mg/kg, while in joint application with histamine it was only 61 mg/kg. Consequently, the toxicity of 5-MOT combined with histamine increased by a factor of 3.5. In experiments on mice, the antihistaminic preparation dimeboline reduced the toxicity of C, but had no influence on the toxicity of TsF and 5-MOT. In experiments on rats, whose sensitivity to histamine is much higher than that of mice, the antihistaminic preparations produce a much more definite effect on the toxicity of the protectors. In the experiments on mice, the radioprotective effect of C and TsF against the background of antihistaminic preparations was not decreased, but there was a definite negative effect of these substances on the antiradiation activity of 5-MOT. Dimeboline of itself did not change the radioresistance of the mice. (ERB)

7059 (CONF-700681-, pp 58-60) BIOCHEMICAL ASPECTS OF THE PROTECTIVE AND TOXIC ACTION OF RADIOPROTECTIVE COMPOUND. Golubentsev, D. A.; Zherebchenko, P. G.; Vladimirov, V. G.; Titov, A. V.; Mikhaylova, E. G. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The radioprotective and toxic effect of cystamine and cystaphos may be associated with the influence of the protectors on the biochemical processes in different organs. To accomplish the protective effect, the accumulation of protectors in radiosensitive organs is of primary importance, while the toxic effects are associated primarily with their penetration into the central nervous system. The toxic effect of protectors develops on the subcellular, cellular, and tissue levels as well as in the intact organism. (ERB)

7060 (CONF-700681-, pp 61-64) CONTENT AND FORM OF PROTECTORS IN SEVERAL ORGANS OF THE RAT FOLLOWING INTRAPERITONEAL ADMINISTRATION OF CYSTEINE, β-MERCAPTOETHYLAMINE, AND CYSTAMINE. Koshcheyenko, N. N.; Filippovich, I. V.; Romantsev, E. F. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The problem of the biochemically active form of protectors is important for the interpretation of the biochemical mechanism of their radioprotective action, so that it is desirable to establish the relative content of thiol and disulfide forms as well as the quantity of protector bound with the cellular proteins in a mixed-disulfide bond, in certain organs of rats which have received intraperitoneal injections of β-mercaptoethylamine (MEA), cystamine, and cysteine. The results which were obtained, based on 1 g of fresh tissue, are shown. When MEA was given the maximum amount of unaltered protector in the spleen and liver was reached in fifteen minutes following administration. During subsequent periods the MEA content in the investigated organs decreased sharply and by the beginning of the third hour amounted to approximately 1/3 of the maximum level. The dynamics of accumulation of MEA in the same organs has a similar nature in the case of intraperitoneal administration of cystamine. The accumulation of MEA in these organs becomes evident only two minutes after administration of cystamine. During the first fifteen minutes the concentration of MEA in these organs increases rapidly, reaching a maximum level in 15 to 30 minutes, then gradually decreases. The dynamics of accumulation of protector in the same organs of the rat following intraperitoneal administration of L-cysteine is similar. However, in this case the disulfide form—cystine—is found in the tissues of the organs in comparatively large quantities. The maximum content of cysteine and cystine is reached fifteen minutes after administration of cysteine and then gradually decreases. (ERB)

7061 (CONF-700681-, pp 65-67) NATURE OF NON-PROTEIN THIOL COMPOUNDS WHICH DEVELOP IN THE TISSUES FOLLOWING ADMINISTRATION OF CYSTAMINE. Titov, A. V.; Mordukhovich, V. V.; Lerner, O. M. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Thirty minutes after the intraperitoneal injection of ^{35}S-cystamine at a dose of 1 millimole/kg (3 mg per mouse) the chromatograms of the extract from the spleen, intestines, kidneys, and blood, besides the reduced glutathione and cysteine, showed only MEA. No other thiol compounds were found. Measurements of radioactivity revealed that in such radiosensitive organs as the spleen and intestines from 76 to 93% of the label belong to MEA. These data indicate that during the period of development of the protective effect (thirty minutes after intraperitoneal administration) the increase in non-protein thiols in the tissues is basically due to the administration of the protector. (ERB)

7062 (CONF-700681-, pp 68-70) INFLUENCE OF IONIZING RADIATION ON THE METABOLISM OF RADIOPROTECTIVE COMPOUNDS CONTAINING SULFUR. Golubentsev, D. A.; Titov, A. V.; Kukushkin, A. V.; Merkina, T. N.; Mordukhovich, V. V. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The metabolism of radioprotectors containing sulfur (cystamine, cysteamine, cystaphos) under the conditions of their prophylactic use prior to general irradiation was studied. In controlled experiments, the same protectors were given to nonirradiated animals. The experiments were performed on 145 rats and 10 dogs. The results of the experiments indicate that the metabolism of the radioprotectors in irradiated animals is characterized by certain features. The data show that the influence of radiation on the organism produces changes in the metabolism of radioprotectors which take the form of a decrease in their excretion with the urine and a change in their distribution in the organism. (ERB)

7063 (CONF-700681-, pp 71-73) DISTRIBUTION OF ^{3}H-MEXAMINE IN THE TISSUES OF MICE AND DOGS AFTER

VARIOUS PATHWAYS OF ADMINISTRATION. Shashkov, V. S.; Merkulov, M. F.; Suvorov, N. N.; Ziya, A. V. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 Jun 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

When ^{3}H-mexamine is given orally, the maximum radioactivity in all investigated tissues was recorded after thirty minutes. The tissues could be arranged in the following order with respect to decreasing radioactivity: kidneys, blood, liver, spleen, muscles, brain. The dynamics of the separation of the radioactive label from the tissues in the case of oral administration of ^{3}N-mexamine is similar to that for intraperitoneal injection. Most of the label is excreted from the organism in six hours. After six hours, approximately 10 to 15% of the radioactivity of the tissues is associated with unchanged mexamine while the rest is apparently associated with 5-methoxyindolylacetic acid. After twenty-four hours, no traces of unchanged mexamine could be found in the organism. (ERB)

7064 (CONF-700681-, pp 74-76) INFLUENCE OF CERTAIN RADIOPROTECTIVE SUBSTANCES ON THE UPTAKE OF ^{14}C-PHENYLALANINE BY THE PROTEIN-SYNTHESIZING SYSTEM OF CELL NUCLEI IN HEALTHY AND IRRADIATED RATS. Nikol'skii, A. V.; Blokhina, V. D.; Romantsev, E. F. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

For further investigation of the mechanism of the action of the radioprotectors, work performed was aimed at a study of the influence of β-mercaptopropylamine (MPA), β-mercaptoethylamine (MEA), and mexamine on the protein-synthesizing activity of the desoxyribonucleoproteid complex (DNP), isolated from the nuclei of the spleen of healthy and irradiated rats, since it is known that the synthesis of protein radiosensitive tissues is inhibited under the influence of radiation. The experiments were performed on male rats weighing 150 to 180 g. The animals were irradiated on the EGO-2 gamma apparatus (^{60}Co) at a dose of 1,000 R ($LD_{50/30}$). It was concluded that the protector participates actively in the synthesis of protein in the cell nuclei of the radiosensitive organ (spleen). Similar results were obtained in a system of isolated nuclei from the spleen. Obviously, radiation and radioprotective substances react directly with the DNP of the nuclei of the cells and the decrease in the synthetic ability cannot be attributed to the action of radiation on the change in permeability of the cell membranes. The acquisition of similar data in the system in vitro and in vivo with MEA and MPA that contain sulfur indicates that the mechanism of radioprotective action of protectors containing sulfur is one in which an important role is played by the interaction of aminothiols with the biochemical substrate of the cell and in particular with the DNP of the nucleus. (ERB)

7065 (CONF-700681-, pp 77-78) RADIOPROTECTIVE ACTIVITY AND TOXICITY OF AET, CYSTAPHOS, AND MEXAMINE WHEN USED SEPARATELY AND IN COMBINATION. Oganesova, T. N.; Ovakimov, V. G.; Yarmonenko, S. P.; Ayrapetyan, G. M. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The protective action of AET, mexamine, and cystaphos was studied on the basis of the number of cells factor of the marrow as a function of the quantity of administered protectors with general irradiation of the animals at a dose of 900 R. On the basis of the data obtained, a mixture was prepared, which included preparations at doses that were not effective if administered separately: AET-25 and mexamine–5 mg/kg (calculated relative to the base), cystaphos–150 mg/kg. A high radioprotective effect for the complex was found with respect to the marrow. The antiradiation activity of the complex was found to be equal to the maximum protective action of AET and cystaphos and exceeded the effect of mexamine. The radioprotective action of the complex and its ingredients in doses that provide a maximum effect with respect to the number of cells of the bone marrow (AET–120, cystaphos–600 mg/kg and mexamine–30 mg/kg) was also studied with respect to the anti-lethal activity and on the basis of cytogenetic tests. The data which we obtained indicate a lower toxicity of the combination in comparison with AET and cystaphos when used at equally effective dose levels. For AET, this dose was 60% of LD_{50}, for cystaphos it was 66%, and for the complex it was 30%. (ERB)

7066 (CONF-700681-, pp 79-81) COMPARISON OF THE RADIOPROTECTIVE EFFECTIVENESS AND SEVERAL PHARMACOLOGICAL PROPERTIES OF A NUMBER OF COMPOUNDS CONTAINING SULFUR. Strel'nikov, Yu. E.; Zherebchenko, P. G. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The investigated protectors differed significantly in toxicity. The preparations may be arranged in the following order in terms of increasing degree of toxicity: monosodium salt S, β-aminoisopropylmonothiophosphoric acid, 1-mercapto-2-aminopropane, monosodium salt S, N, N'-tetramethylcystamine. At the same time, the radioprotective effectiveness of these compounds was about the same. The latitude of the radioprotective effect in this series decreased from the first preparation to the last, i.e., it was maximum for the monosodium salt of S, β-aminoisopropylmonothiophosphoric acid and minimum for N, N'-tetramethylcystamine. As far as the influence of the preparations on the physical tolerances is concerned, such compounds as the monosodium salt of S, β-aminoisopropylmonothiophosphoric acid and cystaphos had no effect on it. However, under the influence of cystamine, cysteamine, N, N'-tetramethylcystamine and 1-mercapto-2-aminopropane the sample indices showed considerable deterioration. The preparations differed significantly also in terms of their influence on arterial pressure and respiration. Thus, cystaphos and the monosodium salt of S, β-aminoisopropylmonothiophosphoric acid had no significant influence as far as changing the arterial pressure and respiration were concerned, while the administration of cystamine and N, N'-tetramethylcystamine led to the development of acute hypotension and we observed a biphasal reaction involving respiration. Hence, the comparative study of a number of sulfur-containing compounds has shown that preparations that are identical in terms of their effectiveness with respect to radioprotection may differ markedly in terms of toxicity, latitude of radioprotective effect, and also with respect to other indices which are very important for the practical utilization of protectors. No direct relationship was observed between the radioprotective activity, toxicity, and other pharmacological properties. (ERB)

7067 (CONF-700681-, pp 82-83) CHANGE IN SEVERAL INDICES OF THE OXIDATION-REDUCTION BALANCE IN THE ORGANS OF RATS SUBJECTED TO THE RADIOPROTECTIVE COMPOUNDS AND RADIATION. Kir'yanov, I. Yu. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

A comparative study was made of several indices of oxidation-reduction processes in radiosensitive organs such as the spleen and thymus, and in a relatively radioresistant organ, the liver. During the action on the organism of the following radioprotectors: cysteine, AET, ATP, dimethylsulfoxide (DMSO) and hypoxia with γ-radiation at a dose of 900 r and with a combination of these protectors and hypoxia with subsequent irradiation, the following parameters were studied: the content of pyroracemic and galactic acid, characterizing the relationship between respiration and glycolysis in tissues; the total content of SH-groups (mercurometric titration); electrometric recording of the oxidation-reduction potential (ORP), and the polarographic determination of the oxygen tension in the tissues. Cysteine and AET produced an increase in the lactate content in all of the investigated organs, indicating an activation of glycolysis in them. Similar, although less pronounced, changes were observed when ATP was injected. The most important changes were observed during hypoxia. Administration of DMSO led to an increase in the lactate content in the liver and a decrease in the amount of the substance in the spleen and thymus which indicates a relative inhibition of glycolysis in the radiosensitive organs when this protector is given. Gamma radiation produced an increase in the lactate content in the spleen and thymus and a decrease of this substance in the liver during the first few hours following the exposure. By the third day the lactate content in the liver had also increased. In the case of irradiation following the administration of all of the above protectors and under the conditions of hypoxia, no significant changes were observed with respect to the normal value in the content of pyruvate and lactate. (ERB)

7068 (CONF-700681-, pp 84) RELATIONSHIP BETWEEN CERTAIN PHARMACOLOGICAL EFFECTS OF BIOGENIC AMINES AND THEIR RADIOPROTECTIVE ACTIVITY. Ayrapetyan, G. M.; Ovakimov, V. G.; Lyarskii, P. P. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

It was found that not only mexamine but serotonin, adrenaline, acetylcholine, and histamine are effective in preventing death from intestinal syndrome. Hence, a correction must be made in the established concepts regarding the ineffectiveness of the tested amines in inflammation of the intestine, based on experiments using relatively low radiation dose levels. The protective effect of adrenaline, acetylcholine, histamine as well as mexamine and serotonin at supralethal doses of radiation develops under the condition that the time of radiation exposure does not exceed the duration of their pharmacodynamic effects on the intestinal vessels. The tested amine compounds are also effective with respect to other radiosensitive systems. The duration and degree of the radioprotective effect of mexamine depend on the quantity of preparation, with the range of its effective dosage being wider in different methods of administration than was earlier supposed. (auth)

7069 (CONF-700681-, pp 85-86) PHARMACOLOGICAL MODIFICATION OF THE RADIOPROTECTIVE ACTION OF CERTAIN PROTECTORS AND THE HYPOXIC EFFECT. Plyushchev, A. K.; Ovakimov, V. G.; Ayrapetyan, G. M.; Tsypin, A. B.; Makarov, V. P.; Ivanov, V. N. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Against a background of inhibition of the higher sections of the central nervous system, caused by deep diethyl anesthesia, the antiradiation effectiveness of 5-MOT mexamine dropped sharply. Thus, while intraperitoneal administration of 5-MOT at the rate of 15 mg/kg given five minutes prior to irradiation at a dose of 800 r resulted in 8.85 ± 1.0 (6.64 to 11.06) million cells of nuclei being left in the femur on the fourth day, administration of the same dose of 5-MOT against the background of deep ether anesthesia meant that only 5.64 ± 0.5 (4.53 to 6.74) million cells were left. When ether anesthesia is given five minutes following administration of 5-MOT there is a sharp rise in the radioprotective effects. In those mice which received 5-MOT fifteen minutes prior to irradiation, the number of myelokaryocytes was 4.7 ± 0.4 (3.86 to 5.6) million; ether anesthesia, begun after administration of 5-MOT-increases the protective effect with respect to the cells in the marrow up to 14.23 ± 1.6 (10.86 to 17.6) million. When ether anesthesia was combined with cystaphos, a reliable change in the radioprotective effect of the protector unlike mexamine was not observed. Thus, with intraperitoneal administration of cystaphos at the rate of 350 mg/kg, given fifteen minutes prior to irradiation, the number of cells with nuclei in mice was 7.14 ± 0.96 (5.09 to 9.2) million. When cystaphos was administered against a background of ether anesthesia, 7.74 ± 0.93 (5.73 to 9.72) million cells were retained. Cystaphos, given twenty-five minutes prior to irradiation, produces a less pronounced protection of the marrow -4.1 ± 0.4 (3.17-5.04) million cells. Ether anesthesia begun fifteen minutes after administration of cystaphos does not produce a reliable increase in this effect -5.58 ± 0.78 (3.9 to 7.25) million cells. (ERB)

7070 (CONF-700681-, pp 88) USE OF GENERALLY ACCEPTED INDICES OF THE STATE OF HEMOPOIESIS FOR A QUANTITATIVE ESTIMATE OF THE ATTENUATION OF THE LETHAL ACTION OF RADIATION. Ovakimov, V. G.; Ayrapetyan, G. M.; Suslikov, V. I.; Ayzina, N. L.; Yarmonenko, S. P. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The degree of coincidence of curves reflecting the probability of death of control animals and protected animals due to deficit of hemopoietic cells was determined. The experiments were performed on white mice and hybrids at dose rates of 710 rads/min and 39 R/min. The lethal effect was determined for a thirty-day period following irradiation with doses of 400 and 1,200 R. As protectors, mexamine and combinations of mexamine with cystaphos, and AET were used. The difference between the probability of death of protected and control animals at a given number of hemopoietic cells reaches 50%. (ERB)

7071 (CONF-700681-, pp 89-92) METHOD OF RAPID PHARMACOLOGICAL EVALUATION OF RADIOPROTECTIVE SUBSTANCES. Rozhdestvenskii, L. M.; Romanov, A. I.; Fedotova, M. I.; Lisina, N. I.; Novoselov, V. S. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The dependence of the cell structure in the marrow on the dose of radiation studied using non-pedigreed white male mice (20 to 23 g) showed that two to three days after the exposure to doses of 150 to 750 R it was practically the same and had the form of a straight line on the normal-logarithmic and logarithmic scales. Four days after irradiation, this relationship had an exponential nature, and the maximum difference with respect to the data obtained after two to three days was observed in the range of relatively small doses (150 to 300 R), obviously due to incipient recovery. When mice were protected by mexamine or mercamine, the dependence of the cell structure of the marrow on the radiation dose had the same nature as in the control animals, but was displaced toward the range of higher doses, thereby reflecting a partial decrease in the radiation dose by the protectors. Both relationships (in the control and protected animals) are represented on the logarithmic scale, using practically parallel lines, thus making it possible to obtain a dose reduction factor which is independent of the radiation dose. (ERB)

7072 (CONF-700681-, pp 93-94) EVALUATION OF THE INCREASE IN RADIORESISTANCE OF TISSUES UNDER THE INFLUENCE OF RADIOPROTECTIVE COMPOUNDS. Fedotova, M. I.; Rozhdestvenskii, L. M.; Romanov, A. I. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

An attempt was made to evaluate, on the basis of the index of the total number of cells two days after irradiation, the radioprotective effect of mexamine and mercamine on the marrow, spleen, and small intestines and to compare the data on the protective effect with the change in these same tissues of the pO_2 and Eh at the time of irradiation. The results of the study showed that the protectors protect the organs in different ways. Mercamine has approximately the same protective effect on all three organs with a FRD of 1.2 to 1.4. Mexamine, however, exerted a pronounced protective effect on the marrow (FRD ~ 2.0), protection of the spleen was less pronounced (FRD ~ 1.6) and the protection of the intestine was weakest (FRD ~ 1.2 on the basis of the number of cells in the mice and 1.2 on the basis of the intestinal form of death in rats). (ERB)

7073 (CONF-700681-, pp 95-97) PROTECTIVE EFFECTIVENESS OF DEXTRAN OF DIFFERENT MOLECULAR WEIGHT IN EXPERIMENTAL RADIATION DAMAGE. Trushina, M. N.; Rogozkin, V. D.; Khomyakov, K. P.; Valakhanovich, A. I. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Results of biological tests of four forms of dextran preparation (prepared at the Minsk Medical Plant) with molecular weights of $1.5 \cdot 10^6$, $3.18 \cdot 10^5$, $1.37 \cdot 10^5$, $0.475 \cdot 10^5$ in experimental radiation sickness are presented. The effectiveness of the preparations was evaluated on the basis of the survival, clinical trend of the disease, change in body weight, and survival time of the animals that died. The prophylactic use of the dextran preparation with a molecular weight of $3.18 \cdot 10^5$ and $1.37 \cdot 10^5$ with brief irradiation at a dose of 800 R using γ rays from ^{60}Co increased the survival rate of the protected mice in all of the investigated doses of dextran by 26 to 63% (with $LD_{37/30}$). The protective action of dextran in a number of experiments took the form of an increase in the survival rate of the animals (with doses of dextran having molecular weights of $3.18 \cdot 10^5$, equivalent to 1,500,900 mg/kg and with molecular weight $1.37 \cdot 10^5$-900 mg/kg) and was statistically reliable. At the same time, the protected mice showed an attenuation of the severity of clinical signs of the disease, and an earlier normalization of body weight in comparison with the controls. This was most clearly evident in those animals that were protected by dextran with a molecular weight of $3.18 \cdot 10^5$ at a dose of 1,500 mg/kg. The use of dextran with prolonged irradiation failed to give a positive effect. (ERB)

7074 (CONF-700681, pp 98-99) INFLUENCE OF PRELIMINARY INJECTION OF RESERPINE ON CERTAIN INDICES OF THE HEMATOPOIETIC SYSTEM IN IRRADIATED RATS. Dorofeev, V. M.; Khnychev, S. S. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2-5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Data are presented on the condition of certain indices of hemostasis in animals that have been irradiated against the background of preliminary administration of reserpine. The experiments were performed on ninety-two Wistar rats weighing 200 to 350 g, of both sexes. Irradiation was performed with γ rays from ^{60}Co in doses of 600 and 800 R at a dose level of 67 to 56 R/sec. Reserpine administered for prophylactic purposes

increased the survival rate of the rats that were irradiated at a dose of 800 R by 27% ($LD_{50/30}$). In those rats that were irradiated at a dose of 600 r, on the eighth day following irradiation there was a drop by a factor of four in the number of blood platelets and by a factor of two in the concentration of serotonin in the blood, by a factor of 2.3 in the ability to achieve aggregation of blood platelets and by a factor of 1.4 in the activity of the XIII factor. The thrombin time of the blood plasma in these animals was lengthened; the tolerance of the fibrin clots to plasmin and the time of recalcification of the plasma were not changed although the free heparin time was increased. Results showed that reserpine does not provide protection against the harmful influence of radiation on certain mechanisms of the blood coagulation system, but does protect to a certain degree against the action of radiant energy on the ability of the blood platelets to achieve aggregation. (ERB)

7075 (CONF-700681-, pp 100-102) BIOLOGICAL EFFECT OF DIMETHYLSULFOXIDE: MECHANISM OF ITS RADIOPROTECTIVE EFFECT. Grozdov, S. P.; Bezin, G. I.; Kenbysh, I. N.; Kir'yanov, I. Yu.; Vasil'evskaya, V. V. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The characteristics of the biological action of DMSO as well as its influence on the development of post-radiational changes in the metabolism were studied. The experiments were performed on male white rats weighing 200 to 230 g. Preliminary intraperitoneal administration of 50% solution of DMSO at the rate of 5.4 g/kg under conditions of γ irradiation at a dose of 900 R led to survival of 14 to 38% of the animals with 100% mortality in the controls and a two-fold increase in the average survival time of the animals which died. At a dose of 7.3 g/kg, the protective effect of the preparation was not increased, and even decreased slightly at 3.7 g/kg. On the basis of a number of chemical indices, DMSO differs from the effect produced by known radioprotective preparations. The total requirement for O_2 of the organism, investigated for two hours after administration of DMSO, showed only a slight tendency toward a decrease. During the first hour following administration of the preparation, the content of pyroracemic acid in the tissues did not change significantly, but a drop in the concentration of galactic acid was observed in the spleen, in the thymus and an increase in the liver which indicates a relative decrease in the intensity of glycolysis in the radiosensitive tissues and its activation in the liver. Administration of DMSO led to a slight decrease in the labile phosphate ATP in the spleen and liver in the course of one hour (by ten and 28%, respectively). The content of electrolytes in the tissues when the preparation was administered did not change significantly. In contrast to the familiar radioprotectors, the action of DMSO is not accompanied by hypoxia or an increase in the content of SH-groups and does not lead to activation but rather to inhibition of the glycolytic process in the radiosensitive tissues. (ERB)

7076 (CONF-700681-, pp 107-110) INFLUENCE OF MEXAMINE ON OXYGEN TENSION IN THE MARROW AND SKIN OF RATS, DOGS, AND MAN. Rampan, Yu, I.; Yarmonenko, S. P.; Berezhnova, L. I.; Osipov, N. E.; Romanenko, I. A. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

The results obtained in the experiments on rats indicate that the decrease in pO_2 in the skin was maximum at a mexamine dose of 3.3 mg/kg, and increasing the dose to 10 and 20 mg/kg only lengthened the period of depression of pO_2. The results obtained with dogs indicate that the change in pO_2 in the subcutaneous tissue may reflect the degree of decrease of pO_2 in the marrow in those cases when small doses of mexamine were used (50 to 100 mg/kg). In man, oral administration of mexamine at a dose of 7.5 mg/kg usually produced a slight (12%) but statistically reliable decrease of pO_2 in the skin. The value of the maximum decrease of pO_2 in individual subjects varied from 0 to 30%. (ERB)

7077 (CONF-700681-, pp 114-115) RADIOPROTECTIVE EFFECT OF DIMETHYLSULFOXIDE AT SUPERLETHAL DOSES OF RADIATION. Fedorovskii, L. L.; Vasil'evskaya, V. V. 1970. Translated from Materials of the First All Union Conference, Pharmacology of Antiradiation Preparations, 2–5 June 1970, Moscow.

From 1st all-union conference on pharmacology of antiradiation preparations; Moscow, USSR (2 Jun 1970).

Preliminary protection of the animals irradiated at a dose of 1,200 R increased the survival of the animals. While all intact rats died on the fourth day after irradiation, more than half of the animals among the protected rats survived for this period of time (about 65%). The remaining rats died at various times until the fourteenth day after irradiation. Analysis of the dynamics of the death of the animals protected by dimethylsulfoxide indicates that the protector converts the intestinal form of death to the marrow variety in almost half of the cases. Dimethylsulfoxide provides very little protection for marrow tissue. On the third day after irradiation, the number of cells in the marrow of intact irradiated rats was about 3.4% of normal, while in the protected animals it was about 6%. On the seventh day the number of cells in the marrow hardly reach 8% of normal. Hence, the radioprotective effect of dimethylsulfoxide at superlethal doses of radiation may be associated with the protection of the intestine by this substance. (ERB)

7078 (COO-1024-51) COMPARISON OF THE CYTOLOGICAL EFFECTS PRODUCED BY IONIZING RADIATIONS OF DIFFERENT LET. Progress Report, March 1973–April 1974. Riley, E. F. Jr. (Iowa Univ., Iowa City (USA)). 1974. Contract AT(11-1)-1024. 22p. Dep. NTIS $4.25.

The effects of various doses and dose rates of fission neutrons and x radiation on the healing of wounds of mouse lens epithelium were studied. The data indicate that the ability of intermitotic cells to respond to wound stimulus and initiate DNA synthesis may not be affected by neutron irradiation in the same way that lens fiber differentiation is affected. It was concluded that different processes with different radiosensitivities and different potentials for recovery may be involved in the short-term wound response and in long-term cataract development. The relation of radiation dose, dose fractionation schedule, and LET to the response of lens epithelium to wounds is discussed. (CH)

7079 (COO-2366-2) DAMAGE AND REPAIR IN SKIN FOLLOWING EXPOSURE TO RADIOACTIVE PARTICLES. Progress Report, June 1, 1973–May 31, 1974. Forbes, P. D. (Temple Univ., Philadelphia, Pa. (USA)). 1974. Contract AT(11-1)-2366. 6p. Dep. NTIS $4.00.

Results are reported from studies on the biological effects of x and uv irradiation on the skin of hairless mice. It was found that one component of the neoplastic process in mouse skin (acute trauma) may be distinguished from another component (chronic radiation damage) on the basis of tumor type produced. Preliminary results of studies on cellular damage and repair are reported. Computer programs were developed for tissue dose distributions studies. (CH)

7080 (COO-2385-1) IRON METABOLISM IN THE X-IRRADIATED ANIMAL. Technical Progress Report, July 1, 1973–June 30, 1974. Mazur, A. (City Coll., New York (USA)). 1974. Contract AT(11-1)-2385. 5p. Dep. NTIS $4.00.

Results are reported from a series of experiments using rats with an intact spleen, injected with ^{59}Fe and then subjected to whole-body x irradiation (900 R) some 12 hr after ^{59}Fe administration. Although there was a sharp drop in erythroid activity in the animals, early samples of circulating red cell hemoglobin contain equal specific radioactivities in Hb V and Hb IV. These results suggest that whatever ^{59}Fe-labelled cells are present in the bone marrow prior to x-irradiation, these get into the circulation very rapidly (rapid maturation) in response to an impaired overall erythropoietic activity of marrow and spleen. It was concluded that marrow erythroid cells labelled at the time of x irradiation are still capable of entering the circulation either as nucleated erythroid cells or reticulocytes. (CH)

7081 (COO-3097-7) EFFECT OF RADIATION ON NORMAL HEMATOPOIESIS AND ON VIRAL INDUCED CANCER OF THE HEMATOPOIETIC SYSTEM. Technical Progress Report, August 1, 1973–July 31, 1974. Okunewick, J. P. (Allegheny General Hospital, Pittsburgh, Pa. (USA). Cellular and Radiation Biology Labs.). 1974. Contract AT(11-1)-3097. 30p. Dep. NTIS $4.50.

Studies on murine viral leukemia have shown that the previously reported resistance of such leukemic animals to lethal doses of radiation is not accompanied by a significant protection of the immune response or post-radiation recovery of that response, at least as measured by the Jerne plaque-forming technique. Preliminary results of other experiments on the infectivity of leukemia virus in irradiated mice show that radiation may increase the sensitivity to the leukemia virus above the normal. Thus, it seems more likely that the radioresistance of viral leukemic mice is more closely related to the leukemia-induced increase in stem cells in the leukemic mouse rather than a leukemia stimulated enhancement of immune response. (CH)

7082 (COO-3167-64) THREE YEAR SUMMARY PROGRESS REPORT, JULY 1, 1970–MAY 15, 1973. Comar, C. L. (New York State Veterinary Coll., Ithaca (USA). Dept. of Physical

Biology; Cornell Univ., Ithaca, N. Y. (USA)). 1973. Contract AT(30-1)-4039. 77p. Dep. NTIS $7.00.

Progress is reported on studies on the biological response of laboratory and domestic animals to various dose levels of external and internal irradiation and the biological effects of implanted radioisotope energy sources proposed for use for artificial heart devices observed during a three-year period in dogs. A list is included of 103 publications during the period covered by this report that present detailed results of these and related studies. Results are reported from studies on the effects of various doses of acute or chronic irradiation on the development and morphology of mouse embryos exposed in vitro during various developmental stages to external γ or x radiation or internally from ^{90}Sr, ^{90}Y, and tritium and on the development of embryos from irradiated parents. The relationship of Vitamin D and calcium-binding-protein to the transport of Ca, Sr, and phosphates across cell membranes was studied. A procedure was developed that permits estimation of the total intake of ^{90}Sr, ^{137}Cs, and ^{131}I by humans following contamination of the environment from any source. Data from studies on the transport of various materials (radionuclides, chemical pollutants, and nutrients) from the environment to milk of cows and goats under given conditions of intake by the lactating animal were used to develop kinetic models and to describe their transfer among various cellular compartments of the mammary gland. The effects of pulsed mixed γ-neutron radiation delivered at doses ranging from 2,570 to 13,600 rads on transient incapacitation of rats and the effects of pulsed γ-neutron and x irradiation on the avoidance behavior of rats were studied. The biological effects of stainless-steel-clad implanted radioisotope power sources (^{252}Cf, ^{90}Sr, and ^{238}Pu) were evaluated in dogs over a three-year period. Results indicated that man will be able to tolerate the radiation doses from implanted ^{238}Pu power sources large enough to supply operating energy for a complete artificial heart. Applications of various nuclear medicine techniques in veterinary medicine are discussed. (CH)

7083 (COO-3380-14) EFFECT OF FRACTIONATED DOSES OF ELECTRONS AND PROTONS ON HAIR FOLLICLES IN THE ALBINO RAT. Strickland, P. T. (New York Univ., N.Y. (USA)). 30 Apr 1974. Contract AT(11-1)-3380. 56p. Dep. NTIS $6.00.

Thesis.

Results are reported from a study of the effect of single and fractionated doses of electrons and protons on Albino rat hair follicles. The survival and regrowth curves of hair follicles following irradiation are presented. Temporary hair suppression was evident from the delay in regrowth of new hair, which was about one day of delay per 100 rads for protons. It was found that permanent growth suppression occurred at 4800 rads for electrons and at a dose greater than 1200 rads for protons. The doses required to produce 50% follicle suppression at ten days post irradiation were 700 rads and 2100 rads for protons and electrons, respectively. A fractionation effect was found for both types of radiation with about 60% recovery for protons and 100% recovery for electrons. (auth)

7084 ELECTRON MICROSCOPIC STUDY OF LYMPHATIC TISSUES OF MICE INOCULATED WITH A LEUKEMOGENIC EXTRACT FROM RADIATION-INDUCED TUMORS. Ricciardi-Castagnoli, P.; Jadin, J. M.; Maisin, J. R. (CEN/SCK, Mol, Belg.). Cancer Res.; 33: 2476-2488(1973).

Macroscopic, histological, and ultrastructural changes in lymphatic tissues, particularly that of the spleen, were studied in C57BL mice inoculated i.p. with a cell-free extract (Passage D from Dr. Duplan) of lymphatic tissues from mice in which leukemia was originally radiation induced. Splenomegaly was observed macroscopically, followed by hypertrophy of lymph nodes. But no change of the thymus was apparent throughout the course of this infection. The histological appearance of the spleen showed hyperplasia of the germinal centers within the lymphatic nodules. The lymphoid cells were replaced progressively by proliferation of the reticular cells and, to a lesser extent, by cells of the plasmocytic line. Typical type C particles were found in the splenic white pulp. During the early stages of this disease, the particles were concentrated in the extracellular spaces within the germinal centers. The infected cells were predominantly immunoblasts, plasmoblasts, plasmocytes, and to a lesser extent lymphoblasts, lymphocytes, and reticular cells. Viral particles could not be detected within megakaryocytes or erythrocytic precursor cells. A few intracisternal type A particles were observed in both plasmocytes and reticular cells. The characteristics of this leukemia are discussed in relation to those described by Kaplan and Rauscher. (auth)

7085 ULTRASTRUCTURAL ALTERATIONS IN THE ANIMAL CNS DURING RADIATION. Tskhadadze, M. Sh. (Inst. of Psychiatry, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 73: No. 3, 717-719(Mar 1974). (In Russian).

An electron microscopic study supports the data obtained by means of light microscopy concerning the interest of particular structures. Acute radiation disease causes the most intensive alterations in the medial region of the thalamus and in the external complexes of cortical layers of the 4th and 17th fields. (auth)

7086 SKIN TOLERANCE TO FRACTIONATED X IRRADIATION IN THE PIG: HOW GOOD A PREDICTOR IS THE NSD FORMULA? Berry, R. J.; Wiernik, G.; Patterson, T. J. E. (Churchill Hospital, Oxford). Brit. J. Radiol.; 47: No. 555, 185-190(Mar 1974).

Fields on the flanks of domestic swine were irradiated with 250 kVp x rays in courses of one, six, or 30 fractions. The acute skin response was scored quantitatively using a numerical scheme. Late skin tolerance, up to one year after exposure, was determined by the presence or absence of skin necrosis in the irradiated fields. The Nominal Standard Dose was a poor predictor for early skin response; an approximately 30% higher equivalent dose was required when administered in six fractions over 18 days to produce either dry or moist desquamation, than was required when given in 30 fractions over 39 days. The difference was even greater when compared with single radiation doses. Late skin tolerance was not closely correlated with the level of early response but skin necrosis was well predicted by the NSD formula. These data in the pig correlate well with clinically determined late skin tolerance in three large radiotherapy centres. For a 64 cm^2 skin field, however, skin tolerance in the pig was reached at a dose of 2,400 rets, one-third greater than the value usually accepted for human skin tolerance. (auth)

7087 EFFECTIVENESS OF AMYTETRAVITE AND ATP DURING PROLONGED IRRADIATION. Rogozkin, V. D.; Tikhomirova, M. V.; Davydova, S. A.; Vodyakova, L. M.; Ostroumova, L. M.; Atamanova, O. M. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 11-14(1974). (In Russian).

In experiments on 109 dogs exposed to a prolonged irradiation with a dose rate of 1 R/min the protection effectiveness of a long-term (2 weeks) administration of amytetravite in combination with ATP was studied. The combined effect of the preparations was investigated at two irradiation doses: 800 R ($LD_{84/45}$) and 700 R ($LD_{75/45}$). A repeated preventive use of amytetravite increasing the nonspecific resistance of the body enhances noticeably the protection effect of ATP. This manifests itself in an increase of the survival rate, a decrease in the severity of radiation sickness, and a decline in the level of hematological changes as compared to the effect of ATP introduced alone. An enhancement of the protection effect of ATP combined with amytetravite is more noticeable at a dose of 700 R: the survival rate of the animals given both preparations is 93% whereas that of the dogs given ATP alone is 60%. A combined treatment with ATP and amytetravite as well as with ATP alone prevent an increase in the level of 11-hydrocorticosteroids in the peripheral blood during the culmination of sickness which is typical of control dogs. (auth)

7088 STATE OF HYPOTHALAMIC NEUROSECRETORY NUCLEI AFTER A COMBINED EFFECT OF ACCELERATIONS AND IONIZING RADIATION. Andrianova, L. A. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 14-17(1974). (In Russian).

When assaying the functional state of hypothalamic neurosecretory nuclei after a combined effect of accelerations and ionizing radiation, it was found that the content of the neurosecretory substance in neurons changed. These changes were similar to those observed 3 h after ionizing irradiation: a tendency towards normalization of the antidiuretic activity of the plasma and accumulation of the secret in neurons of nuclei of the anterior hypothalamus. (auth)

7089 QUANTITATIVE ASSESSMENT OF RADIATION INJURY OF THE SKIN IN MICE AFTER A SINGLE AND FRACTIONAL IRRADIATION. Malenkova, E. N. (Inst. of Experimental and Clinical Oncology, Moscow). Byull. Eksp. Biol. Med.; 77: No. 3, 45-48(Mar 1974). (In Russian).

The coefficient of reduction of radiation injury of the skin in dose fractionation remained constant at the wide dose range (128 to 2850 R). Radiation injury at the dose interval of 50 to 375 R was assessed by the injury of hair follicles during the hair growth period; at the dose interval of 375 to 1900 R assessment was carried out by the integral characteristics of skin injury based on visual observation of the course of the radiation reaction. Preparation of the object and irradiation conditions were strictly identical in both series. For greater precision in the assessment of the injury the data were treated by special mathematical methods. (auth)

7090 SKIN REACTIONS IN MICE AFTER MULTIFRACTION X IRRADIATION. Fowler, J. F.; Denekamp, J.; Delapeyre, C.; Harris, S. R.; Sheldon, P. W. (Mount Vernon Hospital, Northwood, Eng.). Int. J. Radiat. Biol.; 25: No. 3, 213-223(Mar 1974).

Fractionated doses of 240 kV x rays were given to one hind leg of mice, and skin reactions were recorded up to 5 weeks after the last dose. The following schedules of irradiation were used: 15 equal fractions in 18 days (15F/18d), 9F/18d, 9F/10d, 5F/9d, 5F/4d, 3F/4d, 2F/2d, and single doses. The dose required to produce a given average skin reaction over the period 10 to 32 days, or a corresponding period after multifraction doses, increased steadily with time and fraction number; except for the 9F/10d schedule which produced reactions significantly less than would be expected from any simple sequence. The results are discussed in comparison with other experiments on skin. After allowing for concurrent proliferation, a dose-response curve was derived which had a D_q of 550 rads and a straight portion for doses above 1200 rads. The ratio of initial to final slopes was approximately 0.4 and this indicated the ratio of irreparable to reparable x-ray injury in the skin. (auth)

7091 RESTORATION OF CIRCULATION OF THE AUTOTRANSPLANTS OF THE WHOLE RAT GASTROCNEMUS UNDER CONDITIONS OF X IRRADIATION. Umnova, M. M. (Inst. of Evolutional Morphology and Ecology of Animals, Moscow). Byull. Eksp. Biol. Med.; 77: No. 3, 41-44(Mar 1974). (In Russian).

A study was made of vascularization of free autotransplants of whole gastrocnemius to rats in case of local x irradiation of the grafted muscle or of the transplantation bed in a dose of 2500 R. There were revealed differences in the character and the rate of restoration of circulation in the transplants of the irradiated gastrocnemius developing in the nonirradiated bed, as compared to the transplants of nonirradiated muscles in the irradiated bed. As supposed, a slower vascularization of the transplants of the irradiated muscles was associated both with the damaging action of x irradiation on the vessels proper of the transplanted muscles and with the fact that the irradiated muscle attracted the vessels from the bed tissue to a lesser extent than the nonirradiated one. (auth)

7092 DATA ON THE COMBINED INFLUENCE OF X RADIATION AND IMMUNOSUPPRESSIVE PREPARATIONS ON ANIMALS' INFECTIVE COMPLICATIONS. Kaulen, D. R.; Ter-Avetisyan, A. T. Biol. Zh. Arm.; 26: No. 11, 76-81(Nov 1973). (In Russian).

The dynamics of possible infective complications in the form of self-infection in white mice and rats under the combined influence of x radiation and antilymphocytic serum, trimitin, thiophosphamide, and preparations No. 3, 8, and 1787 are studied. The factors considered were time of the appearance of the complication, intensity, duration, and elimination of bacteria from the organism. The variation in the individual white fractions of the blood serum was also determined. (tr-auth)

7093 EFFECT OF IRRADIATION INJURY OF LUNGS ON THE METABOLISM OF GLYCOSOAMINOGLYCANS. Tseveleva, I. A. (Inst. of Biophysics, Moscow). Vop. Med. Khim.; 20: No. 2, 127-131(1974). (In Russian).

Irradiation injury of lungs, caused by α radiation from plutonium, was accompanied by an early increase in total content of acid glycoseaminoglycans. Within 2 to 3 months after the beginning of the experiment there was a distinct increase in content of sulphonated glycosoaminoglycans. There was a correlation between the degree of alteration in components of connective tissue and the dose of radiation absorbed by the organ. The accumulation of glycosoaminoglycans in lungs resulted from the increase in their synthesis due to increase in content of precursors (uridinephosphate glucuronic acid and uridinephosphate acetylglucosoamine). At the same time, the rate of catabolism of the glycoseaminoglycans appeared to be almost unaltered in lungs after radiation injury caused by plutonium. (auth)

7094 DOSE MORTALITY STUDIES ON STRAIN A MICE EXPOSED TO ^{60}Co GAMMA IRRADIATION. Goel, H. C.; Dham, D. N.; Kochhar, B. R. (Inst. of Nuclear Medicine and Allied Sciences, Delhi). Indian J. Exp. Biol.; 11: No. 5, 389-391(Sep 1973).

Variation even at high dose rates affects the pattern of radiation injury as determined by LD_{50} (30). Results have been compared between low and high dose rates exposure groups. LD_{50} (30) for low dose rate exposure groups (4.9 rads/sec) is 590 rads as compared to 850 rads for high dose rate (14.7 rads/sec). However, the dose rate has been found to affect mortality up to the hemopoietic syndrome dose range only and not the gastrointestinal syndrome dose range. (auth)

7095 BIOLOGICAL MECHANISMS DURING HEPATIC REGENERATION. Comparative Study of the Effect of Small Ionizing Radiation Doses and Some Immuno-Suppressions Hormones and Medications. Ghizari, E.; Butculescu, I.; Ciontescu, L.; Ciuntu, L.; Parteni, L. Rev. Roum. Physiol.; 10: No. 4, 317-321(1973). (In Rumanian).

Results of studies on radiobiology and hepatic regeneration obtained in several series of experiments are compiled. The partially hepatectomized rats irradiated 12 hrs before the operation were sacrificed at 20 hrs, the time representing the maxima of the DNA synthesis and the mitotic index. The DNA was isolated and characterized by the N/P ratio, uv absorption, molar absorption ϵ(P), and specific radioactivity of ^{32}P/mg P. These characteristics indicated two important moments during the first 20 hrs of regeneration. The 4-hr DNA is radiosensitive and easily disturbed, but the 6-hr DNA is radioresistant and stable. The action of the hormones insulin, vasopressin, and hydrocortisone is shown by a stimulation of the synthesis of DNA at 4 hrs and a minimum effect on it at 6 hrs. The activity of the transaminases is normalized at 6 hr. It is emphasized that the regeneration is achieved in steps. Azothioprine, an immunosuppressor used in recent years in the treatment of liver ailments, inhibits the DNA synthesis. Studies on the synthesis of mitochondrial protein in the first 40 hrs of regeneration confirm the hypothesis that regeneration follows a sinusoidal curve and can be activated by small doses of x radiation. (tr-auth)

7096 EFFECTS OF X RADIATION ON GROWTH AND FUNCTION OF THE REPAIR BLASTEMA (GRANULATION TISSUE). 2. Measurements of Angiogenesis in the Selye Pouch in the Rat. van den Brenk, H. A. S.; Sharpington, C.; Orton, C.; Stone, M. (Saint Thomas' Hospital, London). Int. J. Radiat. Biol.; 25: No. 3, 277-289(Mar 1974).

The Selye pouch technique was used to stimulate growth of the repair blastema and angiogenesis and measure radiosensitivity of capillary blood vessels in the subcutis. Measurements of radiation damage to the tissue were based on weight per unit area and corresponding DNA content of the repair blastema, the volume of blood produced in the pouch by angiogenesis, and vascular macrocolony counts. Colony counts gave a D_q value of ~240 rads for single-dose and ~180 rads recovery for split-dose irradiation. No significant difference was observed for single doses of irradiation given shortly before or after raising the pouches. Increasing the interval between irradiation of intact skin and raising of the pouch was associated with rapid and marked repair of radiation damage; a delay of 2 to 3 weeks resulted in a dose-reduction factor of 500 to 625 rads for single doses of 1500 to 1800 rads given to intact skin. Local irradiation of an established pouch with a single large dose (2 to 4 krads) rapidly destroyed the inner layer of actively growing angioblastic tissue and caused arrest of haemorrhage; the outer layers of differentiated tissue showed less damage. (auth)

7097 DEFECT IN RNA METABOLISM PRECEDING RADIATION-INDUCED INTERPHASE DEATH OF THYMOCYTES. Geraci, J. P.; Christensen, G. M.; Jackson, K. L. (Univ. of Washington, Seattle). Radiat. Res.; 58: No. 1, 74-82(Apr 1974).

This report characterizes the depolymerization of RNA in x-irradiated rat thymocytes. Loss of uridine-^{14}C label from newly synthesized RNA commences within 1 h of the time of irradiation. Since the shape of the dose-response curve for this effect is similar to the shape of the dose-cell-survival curve, it is suggested that this biochemical lesion may be responsible for interphase cell death. This catabolism of newly synthesized RNA occurs principally in the nucleus and appears to be dependent on continued protein synthesis but not on nucleic acid synthesis. (auth)

7098 INFLUENCE OF SERUM FRACTIONS AND POLYNUCLEOTIDES (POLY I:C) ON BONE MARROW REGENERATION OF SUBLETHALLY IRRADIATED RATS. Hedrich, E.; Havemann, K.; Dosch, H. M.; Ruether, W.; Sodomann, C. P. (Medische Univ., Marburg, Ger.). Verh. Deut. Ges. Inn. Med.; 78: 176-179(1972). (In German).

White Wistar rats were x irradiated with a sublethal dose of 400 R. Nucleotides (Poly I:C) was administered either before or after the irradiation. In the rats injected before irradiation a clear decrease of the bone marrow cells and thymidine incorporation with respect to the controls on the 2nd day was followed by an increase on the 4th day and by renewed decrease on the 6th day. Injections of Poly I:C after irradiation had a much smaller effect. Human blood serum was separated into three fractions and the effect of each fraction on the irradiated rats was tested. Fraction I had no effect, but the 7S fraction leads to a reduction of the bone marrow cells and to an inhibition of the thymidine incorporation during the first four days after the irradiation. An unexplainable increase of the spleen weight occurred simultaneously. The 4S fraction had a clear accelerating effect, especially in thymidine incorporation. (JSR)

7099 EFFECTS OF X IRRADIATION ON PREIMPLANTATION MOUSE EMBRYOS CULTURED IN VITRO. Alexandre, H. L. (Univ., Brussels). J. Reprod. Fert.; 36: No. 2, 417-420(Feb 1974).

Irradiation of two-cell mouse embryos inhibits the differentiation of the blastocyst. If morulae are irradiated, blastocyst formation occurs normally, but the embryos fail to hatch and become cytolytic in the zona pellucida. X irradiation up to 1000 R at an exposure rate of 600 R/min was used. (auth)

7100 LETHALITY-MODIFYING EFFECTS OF NICOTINE ON EXPERIMENTAL RATS. Smith, R. A.; Calkins, J.; Maruyama, Y. (734). Radiology; 111: No. 3, 733-734(Jun 1974).

Male Sprague–Dawley rats were exposed to nicotine by intraperitoneal injection and then given 900 rads of whole-body γ irradiation. The median survival time (ST_{50}) increased in both young and old animals. These results suggest that nicotine, the primary reinforcing factor in tobacco smoke, has a limited radioprotective effect. (auth)

7101 EFFECT OF CYCLOPHOSPHAMIDE, ^{32}P, AND ^{60}Co IRRADIATION ON RABBIT BONE MARROW CELLS. Kissling, M.; Speck, B. (Rijksuniversiteit, Leiden). Blut; 27: No. 3, 167-171 (Sep 1973).

The effect of cyclophosphamide, ^{32}P, and whole-body irradiation on rabbit bone marrow cells was studied. They all proved to be mutagenic. Striking quantitative differences of chromosomal aberrations were found in the three groups. (GE)

7102 INFLUENCE OF GENETIC STRAIN ON THE INDUCTION OF LUNG CANCER IN HAMSTERS BY ALPHA RADIATION. Little, J. B.; Grossman, B. N.; McGandy, R. B.; O'Toole, W. F. (Harvard School of Public Health, Boston). Eur. J. Cancer; 9: No. 11-12, 825-828(Nov 1973).

The response was studied of four inbred strains of Syrian hamsters to multiple intratracheal instillations of the alpha emitting radionuclide ^{210}Po adsorbed onto hematite particles. Marked differences occurred among strains in their tolerance to the instillations. There also appeared to be significant differences in the tumor induction times, but the frequency of lung tumors was similar in the four strains, varying between 33% and 50%. The influence of genetic strain might well be more marked with chemical carcinogens in which mechanisms of activation or detoxification become important factors that come under genetic control. (auth)

7103 AUTORADIOGRAPHIC INVESTIGATION OF THE MECHANISM LEADING TO RADIATION-INDUCED PROLIFERATION OF CARTILAGE CELLS. Knittel, E. Tuebingen, Ger.; Univ. Tuebingen (1972). 26p. (In German).

Thesis.

Autoradiographic methods have been used to investigate whether the growth of the cartilage by apposition, observed several weeks after treatment with ionizing radiation, is a result of a stimulation of proliferation due to the irradiation, or the secondary effect of a tissue damage caused by the irradiation. The investigations have been carried out on the auricular cartilage of the rabbit, one auricular cartilage being irradiated with a single dose of 2,500 R and the other with a single dose of 5,000 R, 48 h prior to the injection of ^{3}H-thymidine. The gamma source used for the experiments was a remote-controlled ^{192}Ir-probe directly touching the auricle. Evaluation of the radiation effects has been made on sufficiently large samples of the skin (squamous epithelium and subcutaneous connective tissue), the perichondrium and the cartilage taken from the central area of irradiation, as well as on samples taken from a non-irradiated part of the auricle. As there were no cells in the DNA-synthesis phase to be found in the perichondrium and the cartilaginous tissue, the hyperplasia of the cartilaginous tissue observed after irradiation cannot have been caused by an initial, radiation-induced stimulation of proliferation. On the basis of the relevant literature it can be concluded that proliferation is not induced by the presence of a proliferation-stimulating substance which may be released by the autolysis of radiation-damaged cells, as the proliferation has been found to set in although no cell death can be detected either prior to or during proliferation. Instead, it is assumed that irradiation inhibits the ability of the cells to resynthetise a proliferation-inhibiting substance. Proliferation starts when the inhibiting substance present in the cells prior to irradiation is depleted. Hence the latency period between irradiation and beginning of proliferation depends on the amount of the inhibiting substance in the cell and above all on the biological half-life of the proliferation-inhibiting substance. (GE)

7104 ESTIMATION IN VIVO OF DNA STRAND BREAKS AND THEIR REJOINING IN THYMUS AND LIVER OF MOUSE. Ono, T.; Okada, S. (Tokyo Univ.). Int. J. Radiat. Biol.; 25: No. 3, 291-301(Mar 1974).

An alkaline sucrose-gradient centrifugation method capable of observing DNA strand breakage and rejoining was used to observe non-dividing and slowly-dividing mouse thymocytes and hepatocytes in vitro and in vivo. The number of radiation-induced single-strand scissions of DNA in cell suspensions in vitro was always slightly greater than in vivo (0.8 ± 0.3 vs 0.6 ± 0.2 in thymocytes and 2 ± 1 vs 0.7 ± 0.4 in hepatocytes). The rejoining of single-strand scissions of DNA was detected in thymocytes both in vivo and in vitro; and in hepatocytes in vivo, but not in vitro during 60 min of incubation. In these systems, the number of radiation-induced breaks declined exponentially with time after irradiation, which suggests that an efficient rejoining system(s) is always present in mouse thymocytes and in hepatocytes. (auth)

7105 ALTERATION OF RADIO-INDUCED MITOTIC DEPRESSION DUE TO ADDITIONAL HIGH-PRESSURE OXYGENATION. Irradiation with Fast Electrons. Pysik, K. P. Essen; Univ. Essen (1972). 40p. (In German).

Thesis.

High-pressure oxygenation has been found to have a marked effect on the mitotic activity of Ehrlich Ascites tumors which, on irradiation with electrons (25 MeV), remained detectable only for one hour following oxygen application. The typical pattern of radiation-induced mitotic depression after a combined treatment of Ehrlich Ascites tumors with irradiation and simultaneous high-pressure oxygenation was investigated. In contrast to irradiation without high-pressure oxygenation, a significant increase in mitotic depression following irradiation with electrons (25 MeV) with simultaneous high-pressure oxygenation has been observed, which reached its maximum at 250 rad. Comparing the combined treatment (irradiation with simultaneous high-pressure oxygenation) with electron irradiation (25 MeV), the latter has been found to lead to stronger mitotic depression than the combined treatment with γ (^{60}Co). (GE)

7106 DNA SYNTHESIS BY EHRLICH ASCITES CARCINOMA AS INFLUENCED BY IONIZING RADIATIONS AND STEROIDS. Boening, L. Tuebingen, Ger.; Univ. Tuebingen (1972). 43p. (In German).

Thesis.

Ehrlich ascites carcinomas in mice have been chosen to study in vivo the effect of irradiation with a tele-cesium source with doses ranging from 500 to 1500 R, combined with i.p. injection of 0.125 mg/g of steroid hormones, on the DNA synthesis using autoradiographic methods. For this purpose, the animals received an i.p. injection of 1 μCi/g of ^{3}H-thymidine 30 min. prior to topping of the ascites. In addition to the inhibition of DNA synthesis due to irradiation alone, a cumulative effect has been found in the experiments, resulting from the combined action of cortisone, percorten, solu-decortin-H or prednisone and irradiation with 1000 R. Application of these hormones prior to irradiation has not shown any radioprotective effect on the tumor cells. (GE)

7107 EFFECTS OF LOW-DOSE X IRRADIATION ON CHROMOSOMAL NON-DISJUNCTION IN AGED MICE. Gosden, R. G.; Walters, D. E. (Cambridge Univ., Eng.). Nature (London); 248: No. 5443, 54-55(1 Mar 1974).

The factors responsible for the increasing incidence of offspring with Down's syndrome in older women are stated to be a continuing subject of debate, and the demonstration of a greater frequency of aneuploid embryos in old mice may open the way for further experimental studies of the causes of some types of chromosomally abnormal conceptions. Clinical evidence suggests that the effect of maternal x irradiation on the incidence of mongoloid children is relatively small. Studies by Yamamoto and others (Nature New-Biol. 244: 206(1973)) are stated to indicate that whereas there was no significant effect of low-dose x irradiation on the ova of young mice, irradiation of old mice causes significantly more chromosomally abnormal ova than did irradiation of young mice. These authors concluded, wrongly in the opinion of the present authors, that the age of the mice significantly affects the susceptibility of oocytes to irradiation damage. The present authors re-examined the data of Yamamoto for evidence of relation between age and effects of x irradiation, and concluded that the data do not show such evidence, and that a differential effect of x irradiation on young and old oocytes is not proven. (UK)

7108 ALTERATION IN LIPID PEROXIDATION OF VARIOUS ORGANS OF RAT AND MOUSE AFTER X IRRADIATION AND THE EFFECT OF PHOTOSENSITIVE DYES ON THESE LIPID PEROXIDATIONS. Aono, K.; Tanabe, M.; Iida, S.; Kumada, Y.; Utsumi, K. (Okayama Univ., Japan). Kanko Shikiso; No. 82, 13-19(Dec 1972). (In Japanese).

When whole-body x irradiation is given to rats, there can be observed an increasing tendency of lipid-peroxidation reaction products in various organs, though only very slightly. When various organ homogenates of rat are incubated in the presence of oxygen at 37°C for 30 min by shaking, the lipid peroxidation

reaction is accelerated, but the degree of such an acceleration generally tends to increase after x irradiation. Lipid peroxidation reaction of various organ homogenates is enhanced markedly by ascorbic acid or Fe^{2+}, and such an accelerative effect increases along with the lapse of time after irradiation. Both the peroxidation reaction of various organ homogenates and the peroxidation reaction accelerated by ascorbic acid or Fe^{2+} are inhibited in the presence of platonin. While subcutaneous or interperitoneal injection of a large dose of platonin prior to x irradiation does not show any change in the lipid-peroxidation activity of organ homogenates, an inhibitory effect on peroxidation reaction is observed especially in liver and spleen within a certain time after interperitoneal injection. (auth)

7109 EFFECT OF 1-MeV FAST-NEUTRON IRRADIATION ON SPERMATOGONIAL PROLIFERATION IN MICE. Influence of Dose Fractionation with Different Intervals. Kramer, M. F.; Davids, J. A. G.; van der Ven, T. P. A. (Rijksuniversiteit, Utrecht). Int. J. Radiat. Biol.; 25: No. 3, 253-260(Mar 1974).

The repopulation of the spermatogonial epithelium in mice after whole-body exposure to 1 MeV fast neutrons was compared for doses from 320 to 400 rads, either single or divided into two fractions 1 to 31 days apart. Repopulation was measured after 11 weeks by determining the percentage of seminiferous tubuli showing signs of spermatogenesis. Dose-fractionation decreased with repopulation more than single exposure, but to a varying degree depending on the length of the interval. Repopulation is lowest for the 1-day interval, indicating a synchronized entry of the spermatogenetic stem cells surviving the first fraction into a very radiosensitive phase of their cycle within 24 hours. For intervals of 12 to 17 days, repopulation shows a maximum resulting either from an increased number of stem cells or from a decreased radiosensitivity at the time of the second exposure. (auth)

7110 DEMONSTRATION IN MOUSE OF X-RAY INDUCED DELETIONS FOR A KNOWN ENZYME STRUCTURAL LOCUS. Erikson, R. P. (Univ. of California, San Francisco); Eicher, E. M.; Gluecksohn-Waelsch, S. Nature (London); 248: No. 5447, 416-418(29 Mar 1974).

Evidence is presented showing that two mutations involving radiation induced alleles that act as early embryonic lethals in mice are deletions extending into the Mod-2 locus, and it is believed that this is the first demonstration in mammals of x-ray induced deletions for an identified enzyme structural locus. The data suggest that mitochondrial malic enzyme may be essential to embryonic development, since the two lethal albino alleles in which its structural locus is deleted are early embryonic lethals. (UK)

7111 DETERMINATION OF SUBCHROMATIDS IN STRUCTURE ORGANIZATION OF CHROMOSOMES IN AMPHIBIAN LYMPHOCYTES TREATED BY UREA. Pankova, N. V.; Sokolov, N. N. (Inst. of Developmental Biology, Moscow). Genetika; 10: No. 3, 35-39(Mar 1974). (In Russian).

It is shown that if freshly drawn amphibian lymphocytes (at the G_2 phase of cell cycle) are treated for 15 or 30 min with 5% urea followed by radiation treatment, the value of chromatid aberrations was above the yield only in the case of x-ray irradiation. These results are in agreement with the data obtained by Wolff in other leukocyte systems. (auth)

7112 RBE VALUES FOR REGROWTH OF C_3H MOUSE MAMMARY CARCINOMAS AFTER SINGLE DOSES OF CYCLOTRON NEUTRONS OR X-RAYS. Fowler, J. F. (Mount Verbib Hospital, Northwood, Eng.); Denekamp, J.; Field, S. B. Eur. J. Cancer; 9: No. 11-12, 853-857(Nov 1973).

RBE values were obtained from the delay in regrowth of first-generation transplanted mammary carcinomas after irradiation with single dose of x rays or neutrons. A decrease of RBE with increasing dose to a minimum value of 2.6 ± 0.6 at about 600 rads of neutrons was found. The results agreed with those obtained previously for delay in regrowth and also for local control of tumors in multi-fraction experiments using small doses per fraction. The RBE values for this carcinoma were not significantly greater than RBE's for skin reactions at low doses per fraction, as was predicted from their shrinkage pattern after large doses of x rays and their known reoxygenation kinetics. (auth)

Invertebrates

Refer also to abstract 6886.

7113 EFFECTS OF GAMMA RADIATION ON THE ULTRASTRUCTURE AND ACID PHOSPHATASE ACTIVITY OF THE MID-GUT OF THE ADULT BEET ARMYWORM, SPODOPTERA EXIGUA. Chilton, B. S. (Arizona State Univ., Tempe). Ann. Entomol. Soc. Amer.; 67: No. 3, 433-441(May 1974).

The effects of gamma radiation on the mid-gut of adult beet armyworms, Spodoptera exigua (Huebner), were investigated with the light and electron microscope. Control moths (0 krad) and moths irradiated with a ^{137}Cs source (20, 40, and 120 krad) were sacrificed 24 and 132 h post-emergence. In control moths, microvilli, a single nucleus, rough endoplasmic reticulum, mitochondria, lysosomes, and a Golgi complex comprise the normal cytoarchitecture of individual columnar epithelial cells. These epithelial cells are supported by a continuous basal lamina, and inner circular and outer longitudinal muscle bands. Tissues of irradiated animals show no disruptions in the nucleus, various organelles, membranes or muscle layers. It appears that sub-sterilizing dosages (20 krad) and sterilizing dosages (40 krad) do not seriously affect the ultrastructure of the mid-gut initially (24 h post-emergence) or with an increase in time (132 h post-emergence). Males irradiated with 120 krad show no radiation effect to the mid-gut, although this dosage produces 50% mortality in 132 h (5 to 6 days). Resistance to the effect of gamma radiation is correlated with the absence of mitotic cell division. Cytochemical studies reveal no increase in acid phosphatase activity when mid-gut tissue from 120-krad-irradiated animals is compared to controls (0 krad). These results further confirm the extreme radioresistance of the mid-gut of Spodoptera exigua. (auth)

7114 EFFECTS OF SIMULATED SPACE ULTRAVIOLET AND VISIBLE RADIATION UPON DRY CYSTS OF COLPODA INFLATA. Giese, A. C.; Rushbrook, P. (Stanford Univ., CA). Photochem. Photobiol.; 19: No. 4, 277-283(Apr 1974).

Dry cysts of Colpoda inflata were irradiated with an argon plasma arc lamp, the output of which simulates space radiation in its wavelength distribution although it is of higher intensity. Rapid evacuation reduced the rate of excystment as well as the percentage excysting; low temperature (near that of liquid nitrogen) had little effect on either measurement. All cysts were therefore irradiated at room temperature in a cell flushed with dry nitrogen. Radiation passed for 1 min through a sapphire filter, with a cutoff at 145 nm, prevented excystment. At smaller doses progressively less damaging effects were observed as judged by both the increase in time required for excystment and the percentage excysted. No dark recovery was observed in dry cysts. Exposure of cysts to radiation passed through a series of filters which progressively remove short ultraviolet wavelengths indicate that it is mainly the quartz-transmitted wavelengths (cutoff 185 nm) which damage the cysts. The presumption is that most of the vacuum-ultraviolet wavelengths are superficially absorbed; their lesser effect is also partially attributable to their lower intensity. Inasmuch as 1 min of argon lamp radiation is equivalent to 24 min in space, it is evident that Colpoda cysts would not long survive a journey in space, had they reached there in viable condition. (auth)

7115 GENETIC EFFECTS INDUCED IN DROSOPHILA MELANOGASTER CULTURED ON IRRADIATED GLUCOSE MEDIUM. Rao, M. A.; Varma, M. B. (Osmania Univ., Hyderabad, India). Indian J. Exp. Biol.; 11: No. 5, 400-402 (Sep 1973).

Drosophila melanogaster was cultured on a medium containing 50 g irradiated glucose, exposed to 200 kr of x rays, in 100 ml of food medium for three successive generations and genetic tests were conducted at each generation. Sex-linked recessive lethals and translocations were screened to study any induced genetic damage and 6 broods of 3 days interval were used for examining the differential response of the male germline. There was a significant difference between the treated and control flies when the total frequencies of sex-linked recessive lethals were taken into consideration, in the 1st, 2nd, and 3rd generations, and in the 2nd and 3rd generations for translocations. It is evident from the results that irradiated glucose can act as a weak mutagen in D. melanogaster. (auth)

7116 EXPERIMENTAL CONTAMINATION AND RADIATION EFFECTS ON PLANKTONIC CRUSTACEA. Macquart-Moulin, C. (Univ., Marseille); Monnier, S.; Rage, P. pp 89-96 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

An ^{131}I labeling technique was developed for studying the vertical migration of planktonic crustaces. The biological half-life for the elimination of ^{131}I from the isopod, Eurydice inermis is defined. The behavior of the level of concentration of ^{131}I in Eurydice inermis was studied as a function of time and contamination of the medium. The effects of radiations on the metabolism of these crustacea were investigated (after expo-

sure to different doses of x rays and after contamination under experimental conditions with ^{131}I). A series of experiments using labeling baths of various activities revealed large concentrations of ^{131}I in the crustacea. (FR)

7117 MORPHOGENETIC MOSAICISM FOR HOMOEOTIC MUTATION ARISTAPEDIA IN DROSOPHILA MELANOGASTER. Ginter, E. K.; Ivanov, V. I.; Mglinets, V. A. (Inst. of Medical Genetics, Moscow). Genetika; 10: No. 3, 67-75(Mar 1974). (In Russian).

Radiation-induced morphogenetic and cellular mosaicism in the antennae of Drosophila melanogaster females was studied after the irradiation of larvae of the T (1:3) 0.5/y sn, ss^a line at ages of 35, 55, 75, and 95 h after oviposition. A considerable individual variation of the character of cell lineage in antennal imaginal discs was observed, which is indicative of a relatively late determination of antennal structures. On the other hand, quite distinct modal types of clonal interrelations between antennal imaginal structures can be established that are virtually similar to those observed in y sn/++ and in y sn/++ ss^a/ss^a flies, which suggests a local type of the process of these structure determinations. Autonomous manifestation of the mutant phenotype ss^a was observed in mosaic spots induced by irradiation of larvae at ages less than 75 h. However, it was not autonomous in several spots induced by irradiation at 75 h age of larvae and in a considerable proportion of spots induced by irradiation at 95 h age of larvae. Nonautonomous manifestation of the ss^a phenotype in spots induced by irradiation at late larval ages suggests that the time interval between 75 and 95 h larval age is the most probable period of the beginning of determination. (auth)

7118 COMPARATIVE INVESTIGATIONS ON THE EFFECT OF X RAYS OR γ RAYS (^{60}Co) ON THE GRAIN WEEVIL (SILOPHILUSGRANARIUS). Wohlgemuth R. (Biologische Bundesanstalt fuer Land- und Forstwirtschaft, Berlin). Z. Angew. Geol.; 74: No. 1, 7-24(Aug 1973). (In German).

Studies on the effect of ionizing radiations on the viability of the adult grain weevil are reported. With similar doses, x-ray treatment was more effective than ^{60}Co radiation. The reason for this effect may lie in the higher RBE of longer waved radiation which could be demonstrated by the percentage of short-living weevils, the time of survival after treatment, and the position of the fertility/sterility border. As expected, the biological effectiveness of radiations within the x-ray spectrum increases with longer wave lengths but this effect could only be partly confirmed statistically. Experiments on the influence of the dose rate with the same radiation doses show a lower effect of treatment with high dose rates. This phenomenon may be of importance for the use of radiation disinfestation in practice, because such irradiation plants must have a high flow of products and therefore a radiation source with a high dose rate is needed. Corresponding with results on other insects on the basis of the form of the survival curves, an injury of the midgut epithelium is suggested as reason for the death of the treated weevils. After irradiation with sublethal doses, treated females are able to produce fertile eggs for a period of two weeks. The fertility of the males is distinctly reduced in comparison with untreated weevils, but a regeneration of the fertility is concluded from the weekly number of progeny. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstract 6539.

7119 HEPATO-SPLEENIC THOROTRASTOMA (γ SPECTROGRAPHIC STUDY). Duriez, R.; Delahaye, R.; Frossard, H.; Prat, G.; Metjes, P. J.; Poutrain, P.; Langlois, J.; Bernard, J. P.; Faure, M. (Hopital d'Instruction des Armees Begin, Saint-Mande, France). Ann. Med. Interne; 124: No. 8, 581-585(Aug 1973). (In French).

Twenty seven years after an intravenous thorotrast injection, radiobiological diagnosis established the existence of thorotrastomas. Radiobiological lesions of the liver and spleen were predominant. The internal irradiation doses received were of the same order of magnitude as the Maximum Permissible Doses fixed by the International Radiological Protection Commission. The observations made demonstrate that permanent irradiation should be avoided as far as possible even when the irradiation doses involved fall below the regulation norms. (FR)

Animals

Refer also to abstracts 6980, 7009, 7101, and 7147.

7120 (AEC-tr-7499, pp 124-128) FORMATION OF THE TISSUE DOSES FROM STRONTIUM-90 AS A FUNCTION OF THE RHYTHM OF ISOTOPE DELIVERY AND THE AGE OF THE ANIMAL. Rasin, I. M.; Sarapul'tsev, I. A.; Burov, N. I. (Inst. of Biophysics, Moscow). 1973. Translated from Radiobiologiya; 13: No. 4, 582-585(1973).

The formation and distribution of tissue doses in the growth zone, spongy and compact bones after single and chronic intake of strontium-90 was studied by the method of autoradiography. The distribution of tissue doses in a cross-section of the lumbar vertebra and the spinal canal was investigated. (tr-auth)

7121 (AEC-tr-7512, pp 146-149) EFFECT OF AMBIENT TEMPERATURE ON DEVELOPMENT AND COURSE OF RADIATION SICKNESS. Zhuraviev, V. F. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

A lethal dose of ^{90}Sr was administered orally to rats. One group was kept at a temperature of 40°C for 4 hrs; a second group was kept at -5°C for 4 hrs daily; and a third group was kept at room temperature of 17 to 18°C. In rats maintained at 40°C, radiation sickness developed more slowly and in a less serious form leading to longer survival. In rats maintained at a low temperature radiation sickness developed at a slower rate and was milder than in controls but more severe than in rats kept at a high temperature. (HLW)

7122 (AEC-tr-7512, pp 207-217) BIOLOGICAL EFFECTS OF SMALL QUANTITIES OF STRONTIUM-90 IN RATS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Strontium-90 was injected intraperitoneally into rats in doses of 1 to 100 μCi. Doses of 1 to 10 μCi did not affect survival time, but doses of 50 and 100 μCi shortened survival time. Experimental animals developed leukemia and neoplasms of the bones, endocrine glands, mammary glands, ovaries, and other organs. The incidence of osteosarcoma and leukemia was proportional to the dose of ^{90}Sr. (HLW)

7123 (AEC-tr-7512, pp 218-235) BIOLOGICAL EFFECTS OF CESIUM-137 IN RATS AND DOGS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Rats were given various doses of ^{137}Cs orally, intravenously, and intraperitoneally. Dogs were given ^{137}Cs subcutaneously. Data are presented concerning acute, subacute, and chronic lethal doses. The toxicity of ^{137}Cs was unrelated to the mode of administration. Agranulocytic and hemorrhagic syndromes and gastrointestinal lesions developed following administration of acute effective doses. In dogs the hemorrhagic syndrome was more marked and necrotic tonsillitis developed which was not present in rats. The appearance and restoration of blood changes were slower in dogs. Following administration of chronically effective doses rats developed inflammation of the lungs, gastrointestinal tract, middle ear, genitourinary tract, and atrophy of the testes. Some tumors of soft tissues developed. Doses that did not affect mean rat survival elicited protracted leukemia and development of tumors. (HLW)

7124 (AEC-tr-7512, pp 236-248) BIOLOGICAL EFFECTS OF BARIUM-140 IN RATS. Strel'tsova, V. N.; Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Barium-140 was administered intraperitoneally to rats in doses of 120 to 1,920 μCi. Observations were made on survival time, weight, hematological changes, and pathological changes in organs. Acute, subacute, and chronic lethal doses were determined. Acute sickness was characterized by development of an agranulocytic syndrome and hyperchromic anemia. The subacute sickness was characterized by recovery of the hematopoietic organs, atrophy of parenchymatous and reproductive organs, and the appearance of bacterial inflammation. The chronic phase was characterized by development of malignant and benign tumors of various tissues and leukemia in some rats. Effects of radiation on hematopoietic tissues were related to the dose rate. (HLW)

7125 (AEC-tr-7512, pp 249-264) BIOLOGICAL EFFECTS OF LANTHANUM-140 IN RATS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Various doses of lanthanum-140 were administered to rats intravenously, intraperitoneally, and orally. The values of acute, subacute, and chronic lethal doses were determined. Observations were made on survival time, hematology, and pathological changes in organs. Acute radiation sickness was characterized by agranulocytosis, hyperchromic anemia, and necrotic lesions of the

gastrointestinal tract. Some animals developed liver cirrhosis and osteosarcomas after long periods of time. (HLW)

7126 (AEC-tr-7512, pp 265-278) RADIATION INJURY CAUSED BY CERIUM-144 IN DOGS, RABBITS, RATS, AND MICE. Strel'tsova, V. N.; Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Various doses of ^{144}Ce were administered to rats, dogs, and rabbits intravenously and to mice intraperitoneally. The values of acute, subacute, and chronic lethal doses were determined. Dogs were 12 to 15 times more sensitive, and rabbits 5 to 7 times more sensitive than mice or rats. Acute radiation injury was characterized by necroses and ulcers of the gastrointestinal tract in rats, mice, and dogs but not in rabbits. The hemorrhagic syndrome was mildly pronounced in rats and mice and predominated in rabbits and dogs. Subacute radiation injury included liver cirrhosis in all animals. Chronic doses caused cirrhosis and tumors of the liver in all animals. Osteosarcomas developed in 50% of rats and rabbits in the chronic stage of the disease. (HLW)

7127 (AEC-tr-7512, pp 279-286) BIOLOGICAL EFFECTS OF SMALL QUANTITIES OF CERIUM-144 IN RATS. Moskalev, Yu. I.; Strel'tsova, V. N. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Cerium-144 was administered intraperitoneally to male and female rats in doses of 1 to 150 μCi. Doses of 20 μCi or less did not affect mean survival of rats; doses of 50 to 150 μCi shortened survival. The rats developed osteosarcomas, leukemia, and tumors of the hypophysis, adrenal glands, thyroid, gastrointestinal tract, liver, kidneys, ovaries, and other tissues. The incidence and time of appearance of osteosarcomas changed according to the dose of ^{144}Ce. No differences between males and females were observed. (HLW)

7128 (AEC-tr-7512, pp 287-297) CHANGES IN PROTHROMBIN TIME AND ERYTHROCYTE DIAMETER IN RATS AFTER SINGLE AND PROLONGED ADMINISTRATION OF STRONTIUM-90. Kalmykova, Z. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Strontium-90 was administered intraperitoneally to rats in single doses of 50 to 1,000 μCi and in cumulative doses of 50 to 1,000 μCi administered daily, twice a month, or once a month. Following administration of cumulative doses the animals died before a change was observed in prothrombin time. Following administration of single doses there was an increase in prothrombin time and a reduction of erythrocyte diameter followed by an increase during the second half of the experiment. The increase in erythrocyte diameter was associated with progressive anemia. (HLW)

7129 (AEC-tr-7512, pp 298-300) EFFECTS OF SOME COMPLEXING AGENTS ON TOXICITY OF STRONTIUM-90 IN RATS. Budko, L. N. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Strontium-90 was administered intraperitoneally to rats in single doses and over a period of two months. The complexing agents hexametaphosphate (HMP), sulfosalicylic acid (SSA), and Na_2 EDTA were given daily for two months by mouth or intraperitoneally. HMP and SSA prolonged survival time but did not prevent development of bone tumors. HMP and SSA lowered the ^{90}Sr level in the skeleton by 17 to 21%. The toxicity of ^{90}Sr was less marked when administered over a long period of time than when given in a single dose. EDTA did not affect survival or ^{90}Sr level in bones. (HLW)

7130 (AEC-tr-7512, pp 301-310) EFFECT OF SPLENECTOMY ON COURSE OF ACUTE RADIATION SICKNESS IN RATS. Buldakov, L. A.; Strel'tsova, V. N. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

A mixture of ^{89}Sr and ^{90}Sr was administered to intact and splenectomized rats in various doses. Splenectomy shortened survival in rats given $LD_{50/30}$ doses and elicited acute radiation sickness in rats given $LD_{50/100}$ doses. Anemia and leukopenia were more marked in splenectomized rats. Medullary hematopoiesis was eliminated in splenectomized rats. Injury to parenchymatous organs was more severe in splenectomized rats. (HLW)

7131 (AEC-tr-7512, pp 311-316) EFFECT OF γ IRRADIATION AND STRONTIUM-90 ON SURVIVAL AND REPRODUCTIVE FUNCTION OF RATS. Budko, L. N. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

When ^{90}Sr was administered to rats in a dose of 0.9 μCi/g, a sterilizing effect was found in females but not in males. Offspring of ^{90}Sr-treated parents showed a higher death rate in the first month than controls, and offspring of ^{90}Sr-treated parents were more sensitive to ^{60}Co γ radiation and strychnine than controls. Virgin rats were more sensitive to toxic effects of ^{90}Sr than those that were bred. (HLW)

7132 (AEC-tr-7512, pp 317-331) COMPARATIVE MORPHOLOGY OF CHRONIC RADIOISOTOPE INJURIES IN MAMMALS. Strel'tsova, V. N. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Rats, rabbits, and dogs were given single injections of ^{90}Y, ^{91}Y, ^{90}Sr, ^{89}Sr, ^{140}Ba, ^{239}Pu, ^{144}Ce, ^{147}Pm, ^{140}La, ^{137}Cs, ^{106}Ru, and ^{95}Nb. Chronic radiation injury proceeded as follows: localized tumors, lesions in hematopoietic organs, leukemia, vascular lesions, emaciation, infection, and death. The kinds of radiation injury were related to dose and tissue distribution of the isotope. The latency period for osteosarcoma was shorter than for tumors of the intestine, mammary glands, endocrine glands, or leukemia. (HLW)

7133 (AEC-tr-7512, pp 332-338) EFFECTS OF PLUTONIUM-239 AND STRONTIUM-89,90 ON RAT BONE MARROW. Tsarapkin, S. R.; Sych, Z. G. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Plutonium-239, ^{89}Sr, and ^{90}Sr were injected intraperitoneally into rats. The rats were killed at intervals and bone marrow was prepared for microscopic examination. A greater radiosensitivity of the erythropoietic system was indicated by a decreased number of erythropoietic cells and an increased number of granulopoietic cells. The ratio between granulopoietic and erythropoietic cells increased following ^{239}Pu treatment, whereas there was a sharp initial rise and subsequent drop following administration of radioactive Sr. Administration of ^{239}Pu elicited a decrease in the number of lymphocytes while the reaction fluctuated following administration of Sr isotopes. Administration of both Pu and Sr isotopes caused a decrease in megakaryocyte content. Pathological mitoses were also observed. (HLW)

7134 (AEC-tr-7512, pp 339-348) CYTOLOGICAL STUDY OF CHANGES IN SPLENIC WHITE PULP OF RATS AFTER ADMINISTRATION OF RUTHENIUM-106. Tsarapkin, S. R. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Ruthenium-106 was injected into the abdominal cavity of rats and observations were made on the numbers and kinds of cells in the spleen follicles. More atrophic and regenerative follicles were seen than in control rats. A dose of 2 μCi/g elicited almost complete disappearance of all follicles except atrophic ones. In all types of follicles there were fewer cells in the spleen of experimental rats than controls and there was a cessation of mitotic activity. (HLW)

7135 (AEC-tr-7534, pp 81-87) INFLUENCE OF IODINE-131 AND STRONTIUM-90 ON THE ENCHONDRAL OSTEOGENESIS IN THE CASE OF THEIR SEPARATE AND COMBINED INTAKE INTO THE ORGANISM. Strel'tsova, V. N.; Moskalev, Yu. I.; Egorova, G. M. (Inst. of Biophysics, Moscow). May 1974. Translated from Radiobiologiya; 13: No. 6, 874-879(1973).

In experiments with a single intake of the thyroidectomic amount of iodine-131, subacute and chronically effective amounts of strontium-90, and the combined influence of these factors, a change in the enchondral osteogenesis in rats with early closing of the epiphyseal plate under the influence of iodine-131 and the combined influence of iodine and strontium-90, was demonstrated, in contrast to strontium-90, which produced a hyperplastic response of the cartilage tissue in part of the rats at definite stages of the subacute and chronic cases of radiation sickness. (tr-auth)

7136 IN VIVO DOSIMETRY OF ^{99m}Tc LUNG SCANNING AGENT. Richter, C. W.; Anderson, D. W. (Univ. of Oklahoma, Oklahoma City). Phys. Med. Biol.; 19: No. 1, 75-78.

Glass encapsulated LiF microdosemeters were used to investigate the x and γ dose delivered to the lungs of dogs by a lung scanning agent used in nuclear medicine. The microdosemeters were injected into the jugular veins of the dogs immediately after the ^{99m}Tc aggregates had been injected. They were small enough to pass through the heart but became lodged in small lung arteries. The dogs were sacrificed one day after the injection so that the dosemeters could be recovered and read out. A value of 189 ± 16 Mrad mCi^{-1} of lodged ^{99m}Tc agent was measured as the average x- and γ-ray dose to the dogs by this procedure. After subtract-

ing the dose to the lungs due to fragmented agent lodged in the liver and spleen, the results were found to be in reasonable agreement with the x and γ dose calculated from estimates of the absorbed fraction. (auth)

7137 AGE DEPENDENT RADIORESPONSE OF LIVER AND INTESTINE IN SWISS ALBINO MICE. Kumar, A.; Mehta, G. (Rajasthan Univ., Jaipur, India). Strahlentherapie; 146: No. 5, 594-598(Nov 1973).

Swiss albino mice of the age groups of one day and three weeks were administered intraperitoneally 1.5 μCi/g body weight of radiophosphorus (P-32). The animals were autopsied at 6, 24, 48, and 72 h after ^{32}P administration. The liver and intestine of three-week-old mice were found more vulnerable to internal irradiation than those of one-day-old mice. (auth)

Plants

Refer also to abstract 6885.

Microorganisms

Refer also to abstracts 6845–6847, 6866, and 7177.

7138 LETHAL AND GENETIC EFFECTS OF RADIOPHOSPHORUS DECAY IN BACTERIOPHAGES SP82G AND T7. Krisch, R. E. (Argonne National Lab., IL). Int. J. Radiat. Biol.; 25: No. 3, 261-276(Mar 1974).

Lethal and genetic effects from the decay of incorporated ^{32}P and ^{33}P were compared in bacteriophages SP82G (B. subtilis) and T7 (E. coli) stored at −196°C or 4°C during decay. Both phages are substantially less sensitive to the lethal effects of ^{33}P than to ^{32}P. Because ^{33}P has a much lower nuclear-recoil energy, the results suggest that nuclear recoil is an important cause of ^{32}P lethality for each phage. Lethal ^{32}P decays in SP82G at either storage temperature appear to correspond to double-strand breaks in DNA. Marker suicide experiments with temperature-sensitive mutants of SP82G indicate two distinct types of lethal lesion resulting from ^{32}P decays: one causes differential interruption of genetic transfer into the infected cell; the second causes interference with the transfer or expression of all genetic markers equally. Similar radiophosphorus experiments with amber mutants of T7 indicate the occurrence of the same two types of genetic lesion. The existence of the first type provides additional indirect evidence that T7, like SP82G, injects its genome in a unique linear sequence, always starting at the left end of the genetic map. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstract 6602.

Man

Refer also to abstracts 6539 and 6548.

7139 (AEC-tr-7471, pp 188-190) FORMATION OF THE DOSE RATE FROM STRONTIUM-90 IN THE GROWING ORGANISM. Rasin, I. M.; Sarapultsev, I. A.; Panteleev, L. I. (Inst. of Biophysics, Moscow). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 469-471(1973).

An investigation of the change in the calcium concentration as a function of age in man and certain agricultural animals has shown that on the scale of "biological time of formation of the skeleton" this dependence is approximated by a linear function. The pattern obtained permitted the establishment of the nature of the variation with age of the dose rate created by one strontium unit in the bone tissue. (tr-auth)

7140 (BNWL-SA-4968) CONSIDERATION OF REACTOR ACCIDENT EXPOSURE GUIDES FOR PLUTONIUM. Bair, W. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 23p. (CONF-740443-2). Dep. NTIS $4.25.

From meeting on fast reactor safety; Los Angeles, California, USA (2 Apr 1974).

An emergency dose for Pu was developed using ICRP models, published data on human leukemia risks from whole-body irradiation, and cancer risk estimates from dog experiments with Pu. These risk estimates of 0.2 for lung cancer, 0.5 for bone cancer, and 1.17 for liver cancer per μCi of $^{239}PuO_2$ inhaled are based on conservative extrapolations from the beagle dog experiments. Using these risk estimates, it was calculated that a 50-year accumulated dose of 10 rem to lung, 25 rem to liver, and 75 rem to bone from a single exposure to Pu were separately equivalent to the cancer risk associated with 25 rem whole-body irradiation. Using the ICRP lung model it was calculated that inhalation of about 20 nCi of $^{239}PuO_2$ with an activity median aerodynamic diameter (AMAD) of 0.5 μm would be risk-equivalent to 25 rem whole-body irradiation. Biological aspects of inhaled Pu, which not only should be considered in developing an emergency reference dose for Pu, but which also contribute a large degree of uncertainty to any emergency reference dose that is developed, include: pulmonary retention and translocation to other tissues; biological effects; species variability; and the development of effective countermeasures for inhaled Pu. (CH)

7141 (LA-tr-74-10) MEASURES TO DETERMINE THE RISK TO WHICH A POPULATION CAN BE SUBJECTED AS A RESULT OF A NUCLEAR ACCIDENT. Iranzo, E.; Ramos, E. (Junta de Energia Nuclear, Madrid (Spain)). 1974. Translation of pp 529-540 from Environmental Contamination by Radioactive Materials, IAEA, Vienna, 1969. 16p. Dep. NTIS $4.00.

This study describes the safety measures taken to protect people living in an area where a radioactive aerosol (Pu and U) had been released to the environment. The reasons to decide against the evacuation of the area and the way the personnel operated or co-operated to check the existence of internal contamination as a consequence of the inhalation of the generated aerosol are also given. In addition a resume of the techniques used to determine the ^{239}Pu burden in the lungs, the amount eliminated with urine, and the results from 100 persons selected for monitoring are given. (auth)

7142 STUDY OF METABOLISM OF ^{42}K BY MEANS OF THE METHOD OF THE WHOLE BODY RADIOMETRY IN THE CLINIC. Palinskashi, D. G.; Ryskulbekov, A. U. (Moscow Medical Inst.). Med. Radiol.; 19: No. 4, 71-73(Apr 1974). (In Russian).

The metabolism of ^{42}K was studied by means of whole-body radiometry in 25 practically healthy men and in 33 patients with different variants of vitium cordis. The following indices of metabolism were studied: content of ^{42}K in tissues, content of ^{42}K in the blood, elimination of ^{42}K from the body. The method of the study is described and the results are compared with results from biochemical electrolyte study. (auth)

7143 REVIEW OF URANIUM INHALATION CASE. Held, K. R.; Fuqua, P. A. (Battelle Pacific Northwest Labs., Richland, WA). Health Phys.; 26: No. 5, 399-403(May 1974).

A case involving chronic exposure to natural uranium-contaminated atmosphere over a 14 yr period is discussed. In vivo examination data, including some obtained following an extended absence from work, are used, along with other supporting data, to evaluate the resulting lung dose. In vivo chest examination data are compared to results of four samples of lung tissue and three lymph nodes that were analyzed for uranium content using both neutron activation and fluorometry techniques. As a result of the study conducted, the routine surveillance program for uranium workers was changed. (auth)

7144 DETERMINATION OF INCORPORATED RADIOACTIVE SUBSTANCES. Schieferdecker, H. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 3, 18-24(Nov 1973). (In German).

A survey is given of the general principles and possibilities of determining the incorporation of radioactive substances. Furthermore, practical methods are discussed to derive from these measurements the dose to the whole body and to individual organs. (GE)

7145 BEHAVIOR OF TECHNETIUM-99m IN SALIVARY GLANDS. Muenzel, M.; Hochstrasser, K.; Eichner, H. (Univ., Munich). Z. Laryngol., Rhinol., Otol.; 52: No. 11, 818-821(Nov 1973). (In German).

The concentration of intravenous technetium-99m in the salivary tissue was investigated in man and in guinea pigs. Sephadex-Gelfiltration showed that 25 to 30% of the isotope was bound to high molecular proteins in a complex manner. This binding can be dissolved by the addition of ethylenedinitrolotetraacetate to the buffer solution. The mechanism and significance of this complex formation in salivary tissue are discussed. (GE)

7146 METHODS OF MEASURING RETENTION OF RADIOISOTOPES IN THE KNEE AND EXTRA-ARTICULAR SPREAD IN VIVO. Williams, E. D. (Hammersmith Hospital, London). Ann. Rheum. Dis.; 32: No. 6, Suppl., 13-16(Dec 1973).

From symposium on radioactive colloids in the treatment of arthritis; Harrow, Eng. (6 Jul 1973).

In assessing different radiopharmaceuticals or treatment regimes for intra-articular therapy, it is useful to know the fate of the radionuclide. The preferred nuclide is ^{90}Y, since it emits

only β radiation, and the best method for measuring retention in the knee is by counting the bremsstrahlung with two opposed stationary detectors. Uptake in lymph nodes and liver may be of secondary importance, but the site of uptake can be positively identified by scanning and the amount of uptake determined by using dual detector quantitative scanning techniques. (UK)

Animals

Refer also to abstracts 5928, 6476, 6492, 6549, 6958, 7082, and 7116.

7147 (AEC-tr-7512) DISTRIBUTION, BIOLOGICAL EFFECTS, AND MIGRATION OF RADIOACTIVE ISOTOPES. Lebedinskii, A. V.; Moskalev, Yu. I. (eds.). 1961. Translation of Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961. 408p. Dep. NTIS $10.60.

Separate abstracts were prepared for the 41 papers in this English language translation of the Russian publication. (HLW)

For abstracts of individual papers see: 6529, 6539, 7121–7134, 7148–7171, and 7177.

7148 (AEC-tr-7512, pp 4-19) DISTRIBUTION OF CESIUM-137 IN THE ANIMAL ORGANISM. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Cesium-137 was administered to rats intravenously, intraperitoneally, subcutaneously, and orally. Following intravenous injection, the ^{137}Cs disappeared rapidly from the blood and was uniformly distributed in organs and tissues. The highest concentrations of ^{137}Cs were in the kidneys, jejunum, salivary glands, myocardium, and thyroid. The largest quantities were in the muscles, kidneys, and liver. Very small quantities occurred in the skeleton. Six times more ^{137}Cs was excreted in the urine than in the feces. Following oral administration 100% of the ^{137}Cs was absorbed. (HLW)

7149 (AEC-tr-7512, pp 20-28) DISTRIBUTION AND ACCUMULATION COEFFICIENTS OF STRONTIUM-90, CESIUM-137, AND PHOSPHORUS-32 IN PIGS AND DOGS. Il'in, D. I.; Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Radioisotopes were added to the diet of pigs for 85 days, and radioactive pork was added to the diet of dogs. Dogs were also given ^{90}Sr, ^{90}Y, ^{32}P, and ^{137}Cs. Strontium, cesium, and phosphorus were well resorbed from the gastrointestinal tract of pigs and dogs. Most of the cesium was found in the muscles and most of the phosphorus in the skeleton. The period of effective elimination from soft tissues was 15 to 30 days for ^{137}Cs and 6 to 9 days for ^{32}P. Results may be used to estimate maximum permissible levels of ^{137}Cs, ^{90}Sr, and ^{32}P in food products for domestic animals and man. (HLW)

7150 (AEC-tr-7512, pp 29-44) DISTRIBUTION OF BARIUM-140 IN RATS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Barium-140 was administered to rats intravenously, intraperitoneally, subcutaneously, and orally. Tables are presented to show concentrations in various organs following administration. The influence of sodium citrate, heparin, and EDTA on the distribution and elimination of ^{140}Ba was studied; no significant effects were found. Following intravenous injection, ^{140}Ba was deposited primarily in the skeleton. Highest concentrations in soft tissues occurred in the kidneys, stomach, salivary glands, and thyroid. Data are also presented on quantities of ^{140}Ba excreted in urine and feces. (HLW)

7151 (AEC-tr-7512, pp 45-59) DISTRIBUTION OF LANTHANUM-140 IN RATS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Lanthanum-140 was administered to rats intravenously, intraperitoneally, intramuscularly, subcutaneously, and orally. Following intravenous administration, most of the ^{140}La was deposited in the liver, skeleton, and kidneys. High concentrations were also observed in the adrenal glands, bone marrow, spleen, ovaries, and lymph nodes. Extremely small quantities of ^{140}La were absorbed from the gastrointestinal tract. Administration of EDTA accelerated the elimination of ^{140}La considerably. (HLW)

7152 (AEC-tr-7512, pp 60-92) DISTRIBUTION OF CERIUM-144 IN ANIMALS. Moskalev, Yu. I.; Kulikova, V. G. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Tracer amounts of ^{144}Ce were administered intravenously or intraperitoneally to guinea pigs, mice, rabbits, cats, dogs, and frogs. The animals were killed at intervals and the radioactivity in various organs was determined. The pattern of distribution was identical in the organs of different animals. The liver and skeleton contained the largest amounts of ^{144}Ce. Frog livers contained 3 to 4 times less ^{144}Ce and frog skin 20 to 50 times more than that of mammals. The rate of excretion of ^{144}Ce from the liver differed in the various animals. Deposition of ^{144}Ce in the skeleton was substantially influenced by species and age of the animal. (HLW)

7153 (AEC-tr-7512, pp 93-97) DISTRIBUTION OF RUTHENIUM-106 IN MAMMALS AND AMPHIBIANS. Buldakov, L. A. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Ruthenium-106 was administered intraperitoneally to mice, rats, guinea pigs, cats, dogs, and frogs. The animals were killed at intervals and the radioactivity of various tissues was determined. A relatively uniform distribution of ^{106}Ru in various organs of the animals was observed. The intensity of absorption from the abdominal cavity and elimination from the animal paralleled the degree of metabolism. (HLW)

7154 (AEC-tr-7512, pp 98-104) ROUTES OF CESIUM-137, STRONTIUM-89, AND CERIUM-144 ABSORPTION IN DOGS. Buldakov, L. A. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

The routes of absorption and the circulation of ^{137}Cs, ^{89}Sr, and ^{144}Ce in dogs were examined following intracutaneous, intraperitoneal, intravenous, and oral administration. Cesium-137 and ^{89}Sr were absorbed from the skin and abdominal cavity primarily by blood capillaries, while ^{144}Ce was absorbed primarily by lymph capillaries. Following intravenous administration, ^{137}Cs was removed from the blood at the fastest rate while ^{144}Ce was removed at the slowest rate. Strontium-89 showed the highest concentration in lymph. (HLW)

7155 (AEC-tr-7512, pp 105-107) STRONTIUM-90 ABSORPTION THROUGH THE INTACT SKIN OF RATS. Budko, L. N. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Strontium-90 was applied to the skin of rats and one hr later the same area of skin was saturated with 4% Na_2 EDTA or 2% TMP (trimetaphosphate) solution. Six hrs later 0.3% of the ^{90}Sr had penetrated the skin. After 12 days the skeleton contained 4% of the ^{90}Sr. Strontium-90 absorption was increased three-fold by EDTA, while the absorption was diminished 1.5 times by TMP. (HLW)

7156 (AEC-tr-7512, pp 108-112) CERIUM-144 ABSORPTION THROUGH THE RAT SKIN AND EFFECT OF Na_2EDTA ON ABSORPTION. Rogacheva, S. A. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Cerium-144 was applied to the skin of rats and 4% Na_2EDTA solution was applied at intervals up to 2 hrs later. Six hrs after the ^{144}Ce was applied, 0.02% was demonstrable in the skeleton, 0.0022% in the liver, and 0.12% in the muscles. Absorption occurred primarily during the first hrs after application to the skin. EDTA intensified absorption through the skin. A table is presented to show ^{144}Ce content of various organs. (HLW)

7157 (AEC-tr-7512, pp 113-119) DISTRIBUTION AND ELIMINATION OF STRONTIUM-90 AND CERIUM-144 IN RATS FOLLOWING SUBARACHNOID ADMINISTRATION. Buldakov, L. A. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Strontium-90 and ^{144}Ce were injected into the subarachnoid space of the rat brain. The radioisotope content of various organs was determined at intervals up to 16 days and results are tabulated. Cerium-144 was absorbed at a slower rate than ^{90}Sr and ^{144}Ce did not penetrate the grey and white matter of the brain. Strontium-90 was selectively deposited in the skeletal system. (HLW)

7158 (AEC-tr-7512, pp 120-127) DISTRIBUTION OF CESIUM-137 AND STRONTIUM-89 IN RATS FOLLOWING INHALATION. Moskalev, Yu. I.; Buldakov, L. A.; Semenov, D. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Rats were exposed to ^{137}Cs and ^{89}Sr aerosols for 5 min by means of a special inhalation device. At intervals up to 32 days the rats were sacrificed and the radioisotope content of various organs was determined. About 10% of the ^{89}Sr and 15.5% of the ^{137}Cs penetrated into the lungs. The isotopes were completely absorbed from the lungs within the first day. The distribution of resorbed ^{137}Cs and ^{89}Sr was the same as that following intravenous or oral administration. (HLW)

7159 (AEC-tr-7512, pp 128-141) EFFECT OF AGE AND SEVERED SCIATIC NERVE ON DISTRIBUTION OF CESIUM-137 AND STRONTIUM-89,90 IN RATS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

After severing the sciatic nerve of one of the hind legs, ^{137}Cs was administered intraperitoneally to 2-month-old rats. Strontium-89 and ^{90}Sr were administered subcutaneously to 3- to 4-week-old rats and to 6- to 7-month-old rats following denervation. The radioisotope content of the gastrocnemius muscle, femur, and tibia was then determined. Less ^{137}Cs was deposited in muscle and more in the bones of adult rats than in young ones. Strontium accumulated in larger quantities in bones and smaller quantities in muscles of young rats. A decrease in Sr and Cs content of the gastrocnemius muscle, femur, and tibia was observed in the leg with the severed sciatic nerve. (HLW)

7160 (AEC-tr-7512, pp 142-145) EFFECT OF AMBIENT TEMPERATURE ON DISTRIBUTION OF STRONTIUM-90 IN ALBINO RATS. Zhuravlev, V. G. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Strontium-90 was administered orally to three groups of rats. One group was kept at a temperature of 40 to 41°C, the second at −4 to −6°C, and the third at room temperature of 17 to 18°C. At intervals of 5 days rats were sacrificed and the radioactivity of various organs was determined. Elevation of temperature resulted in less accumulation of ^{90}Sr in the rat tissues and intensified excretion in feces and urine. Low temperatures caused prolonged retention in the tissues and a slower rate of excretion. As a result of exposure to low temperatures there was a gradual accumulation of ^{90}Sr in bone tissue due to decreased accumulation in other organs. (HLW)

7161 (AEC-tr-7512, pp 150-155) EFFECTS OF DIET ON METABOLISM OF STRONTIUM-89,90 AND CESIUM-137 IN RATS AFTER PERORAL AND INTRAPERITONEAL ADMINISTRATION. Rogacheva, S. A. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Following intraperitoneal administration of ^{137}Cs, ^{89}Sr, and ^{90}Sr to rats, the effects of eight different diets on the metabolism of these isotopes were studied. The effects of EDTA, trimetaphosphate (TMP), and folliculin on Sr metabolism were also studied. The absorption of Sr from the gastrointestinal tract was increased by a calcium-deficient diet and decreased by a high fat and calcium diet. The diets did not have a significant effect on retention of Sr in the rat skeleton. Rats maintained on rachitogenic and protein diets excreted more Sr in urine than controls. EDTA diminished deposition of Sr in the skeleton when diets containing excessive phosphorus, carbohydrate, and calcium were used. With the use of TMP, a high calcium diet increased Sr retention in the skeleton. Folliculin had little effect on Sr retention in the skeleton. (HLW)

7162 (AEC-tr-7512, pp 156-162) EFFECT OF IMPAIRED MINERAL METABOLISM ON RATE OF ELIMINATION OF RADIOSTRONTIUM FROM RATS. Selivanova, L. N. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Following subcutaneous injection of ^{89}Sr and ^{90}Sr rats were kept on diets for 50 days. The following diets were used: a diet enriched with calcium and deficient in phosphorus (rachitogenic diet) and a diet enriched with strontium bromide and deficient in calcium and phosphorus. The effects of parathyrokrin combined with the diets were also investigated. The rachitogenic diets intensified excretion of radioactive strontium and this led to decreased accumulation of strontium in the tissues for the first 10 to 15 days. After 50 days both diets elicited rickets that disappeared 20 days after the animals were returned to their usual diet. Parathyrokrin did not influence the effectiveness of the diets, but did elicit greater disturbances in osseous tissue. (HLW)

7163 (AEC-tr-7512, pp 163-169) EFFECT OF X-IRRADIATION ON DISTRIBUTION OF CESIUM-137 IN RATS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Cesium-137 was administered intravenously or intraperitoneally to rats and the rats were x-irradiated in doses of 50, 200, and 600 R. On the 4th to 8th days following a 600 R dose there was an increased level of ^{137}Cs in the blood, liver, lungs, gastrointestinal tract, testes, kidneys, and adrenals and a decreased level in the skeleton, bone marrow, and spleen. Excretion in the feces was increased and in the urine was decreased. Doses of 50 and 200 R had no effect. (HLW)

7164 (AEC-tr-7512, pp 170-174) EFFECT OF ISOTOPE CARRIER ON DISTRIBUTION OF CESIUM-137 IN RATS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Rats were given intravenous and intraperitoneal injections of ^{137}Cs in quantities of 10 and 30 mg. The distribution of ^{137}Cs was not influenced by the different quantities. During the early stages following administration the larger quantities of ^{137}Cs were eliminated more slowly from the blood stream, and larger quantities were deposited in the testes, muscles, and smaller quantities in the kidneys and heart. (HLW)

7165 (AEC-tr-7512, pp 175-184) EFFECTS OF PRELIMINARY ADMINISTRATION OF STABLE STRONTIUM, CALCIUM, AND PHOSPHORUS ISOTOPES ON DEPOSITION OF RADIOSTRONTIUM IN THE RAT SKELETON. Razumovskii, N. O.; Torchinskaya, O. L. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Rats were given stable isotopes of strontium, calcium, and phosphorus by mouth or subcutaneously at different times prior to administration of ^{89}Sr and ^{90}Sr. No appreciable effect of stable isotopes was found on incorporation of ^{89}Sr and ^{90}Sr in the femur or teeth. A mean decline of only 10 to 15% was found. A fluctuation in excretion of radiostrontium by the kidneys and intestine occurred. Stable strontium loads of 7.2 and 14.4 mg daily caused strontium rickets in rats within 2 to 3 weeks. (HLW)

7166 (AEC-tr-7512, pp 185-191) INFLUENCE OF ISOTOPE CARRIER ON DISTRIBUTION OF CERIUM-144 IN RATS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Rats were injected intravenously and subcutaneously with ^{144}Ce; trivalent and tetravalent stable cerium was administered as the isotope carrier and calcium was administered as the nonisotope carrier. The rats were killed at intervals and radioactivity of various organs was determined. The isotope carrier sharply altered distribution, excretion, and absorption of ^{144}Ce. Following subcutaneous injection there was a decreased absorption from subcutaneous tissue; following intravenous injection there was a decreased excretion in the feces and increased deposition in the spleen, bone marrow, lungs, adrenal glands, and ovaries. The nonisotope carrier increased absorption from subcutaneous tissue and when administered intravenously it increased the ^{144}Ce content of bone tissues. (HLW)

7167 (AEC-tr-7512, pp 192-196) EFFECT OF pH OF INITIAL SOLUTION ON DISTRIBUTION OF CERIUM-144 IN RATS. Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Cerium-144 preparations were made using hydrochloric acid and caustic soda solutions of varying normality. At intervals following intravenous administration rats were killed and the ^{144}Ce content of various organs was determined. With an increased pH of the solution the level and rate of deposition of ^{144}Ce increased in the liver, spleen, bone marrow, and adrenal glands but decreased in the skeleton and kidneys. In time, the differences in deposition of ^{144}Ce in the liver, kidneys, and skeleton in relation to pH disappeared, but they persisted for 30 days in the spleen. Total excretion of ^{144}Ce in the urine and feces was unrelated to pH, but more intense elimination was observed during the first day with low pH values. (HLW)

7168 (AEC-tr-7512, pp 197-201) EFFECTS OF SOME PHYSICOCHEMICAL FACTORS ON DISTRIBUTION OF RUTHENIUM-106 IN RATS. Baldakov, L. A. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

The effects of the following on tissue distribution of ^{106}Ru in rats were studied: pH, stable Ru as a carrier, and the ammonium salt of nitrosopentachloride. With an increased pH from 0.5 to 6.4 there was increased deposition of ^{106}Ru in the liver and spleen and a decreased deposition in muscles. The rate of excretion was unrelated to pH. The isotope carrier decreased deposition of ^{106}Ru in the liver and retarded elimination from the liver, spleen, and muscles. The ammonium salt of nitrosopentachloride was depos-

ited in larger quantities in the liver; the increased retention in muscles was proportional to increase in dose weight of the salt. (HLW)

7169 (AEC-tr-7512, pp 202-206) ACCELERATED EXCRETION OF RADIOACTIVE STRONTIUM-90 FROM THE RATS UNDER THE INFLUENCE OF SOME OXYQUINOLINE DERIVATIVES. Boiko, N. S. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Following oral administration of ^{90}Sr to rats, 36.9% of a given dose was excreted in feces and 1.3 to 4% in urine within 50 days. Administration of quinine did not accelerate elimination and did not alter accumulation or distribution in tissues. Atophan increased fecal excretion by 2- to 4-fold and decreased deposition in the femur by 1.5- to 4-fold. (HLW)

7170 (AEC-tr-7512, pp 375-378) ACCUMULATION OF STRONTIUM-90 IN YOUNG CARP. Lebedeva, G. D. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Laboratory studies were conducted on $^{90}Sr-^{90}Y$ uptake by two-week old carp and verkhovka (carp-like fish). Two-week-old fish accumulated $^{90}Sr-^{90}Y$ much faster than year-old fish. Accumulation was about the same for carp and verkhovka. When the specific activity of the water was low, there was relatively more accumulation than with higher concentrations. The usefulness of young fish as biological indicators of radioactive contamination is pointed out. (HLW)

7171 (AEC-tr-7512, pp 379-387) DISTRIBUTION, ELIMINATION, AND COEFFICIENTS OF ACCUMULATION OF STRONTIUM-90, CESIUM-137, AND PHOSPHORUS-32 IN FISH. Il'in, D. I.; Moskalev, Yu. I. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Perch and roach were kept for two years in an experimental reservoir with a constant level of ^{90}Sr, ^{32}P, and ^{137}Cs. The fish were transferred to an activity-free pond to determine the rate of elimination of the isotopes. The fish were removed at intervals and the radioactivity of various organs was determined. Cesium-137 was distributed uniformly in the different organs. Concentrations of ^{90}Sr were 10 to 30 times higher in the scales, fins, and bones than in the internal organs. Phosphorus-32 was uniformly distributed. Data are also presented on the effective half-life of elimination of the isotopes. (HLW)

7172 (AEC-tr-7471, pp 185-187) PHYSICOCHEMICAL STATE OF YTTRIUM-91 IN BLOOD SERUM. Mikshevich, N. V.; Sukhacheva, E. I. (Ural Scientific Center, Sverdlovsk, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 466-469 (1973).

The state of yttrium-91 in the blood serum of rats in the case of intravenous injection of the emitter was studied by the method of gel filtration on Sephadex G-200. It was found that the amount of yttrium-91 bound by the serum proteins depends on the rate of injection of the radioisotope and its dose. A substantial sorbability of yttrium-91 by Sephadex and glass was noted. (tr-auth)

7173 (BNWL-SA-4867) RELATIVE QUANTITY OF AIRBORNE PLUTONIUM DEPOSITED IN THE RESPIRATORY TRACT AND ON THE SKIN OF RATS. Craig, D. K.; Mahlum, D. D.; Klepper, E. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 15p. (CONF-740702-1). Dep. NTIS $4.00.

From Health Physics Society annual meeting; Houston, Texas, USA (7 Jul 1974).

In assessing the hazard of exposure to airborne plutonium, questions arise as to the relative importance of material deposited within the respiratory tract and on skin. To provide relevant deposition data, shaved rats were exposed to a $^{238}Pu(NO_3)_4$ aerosol in a low-speed wind tunnel. Half were oriented with noses facing upstream, the other half with noses downstream. Samples of the airstream were taken during exposure to determine the aerosol concentration and its aerodynamic equivalent size distribution. Calculations of the quantity inhaled were made from the aerosol concentration, minute volume and exposure time; skin deposition was estimated from the aerosol deposition velocity, area of exposed skin and exposure time. Immediately after exposure, the rats were sacrificed, skinned and dissected and the plutonium activity on the skin compared to that in lungs, head and intestines. Rats with their noses downstream inhaled only 66% as much as the upstream group. In both cases, about 40% of the inhaled material was in the lower respiratory tract, about 40% in the head and 20% in the intestines. Plutonium deposited on the skins of the two groups was almost identical, being 22 to 33% of the respiratory tract value. Measured values agreed with the calculated values within a factor of two. (auth)

7174 USE OF ^{133}Xe IN STUDIES OF CEREBRAL BLOOD FLOW. Rage, P.; (CNRS, Marseille); Monnier, S.; Vigouroux, R. A. pp 337-346 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The work effected on monkeys and cats demonstrated the usefulness of ^{133}Xe in studies of cerebral hemodynamic phenomena, animal irradiations, and experimental techniques. Xenon-133 clearance and diffusion mechanisms in cerebral tissues were investigated together with the variation in the radioactivity of the arterial blood and expired air of monkeys as a function of time. The results of different experiments (variations in the dose resulting from direct injections into the cerebral cortex and carotidal tract) are compared. (FR)

7175 CHELATING AGENTS AND THE TRANSFER OF HEAVY METALS ACROSS THE MUCOSAL EPITHELIUM. Forth, W.; Nell, G.; Rummel, W. (Univ. Saarland, Homburg, Ger.). pp 339-345 of Trace Substances in Environmental Health. Hemphill, D. D. (ed.). Columbia, MO; Univ. of Missouri (1973).

From seventh annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973). See CONF-730613-.

The influence of 8-hydroxyquinoline and its 5-sulfonic acid derivative on the absorption of ^{59}Fe, ^{60}Co, ^{54}Mn, ^{64}Cu, and ^{65}Zn was investigated on tied off jejunal segments in situ of rats. The fraction of dose absorbed of ^{59}Fe, ^{60}Co, ^{64}Cu, and ^{65}Zn was decreased by the sulfonic acid derivative and increased by 8-hydroxyquinoline as compared with that obtained after having administered the non-chelated metals. Neither chelating agent had an effect on the absorption of ^{54}Mn. L-Histidine in lower concentrations (hist/metal = 100/1) increases both the transfer across the mucosal epithelium and the tissue content of ^{64}Cu, ^{59}Fe, and ^{65}Zn on isolated perfused jejunal segments in vitro of rats. Higher concentrations of L-histidine (hist/metal ≥ 1000/1) decrease both transfer and tissue content of the radioactive metals. In general, there are two groups of heavy metal chelates: chelates of low effective stability release their metals to the acceptor sites of the transfer systems for metals in the mucosal cells and chelates of high effective stability do not release their metals to the acceptor sites of the mucosal cells. The latter chelates are absorbed according to the rules for drugs and foreign compounds. (auth)

Plants

7176 UPTAKE OF ^{226}Ra BY PLANTS FROM CONTAMINATED SOILS. Grzybowska, D. Nukleonika; 19: No. 1, 71-78 (1974).

The ^{226}Ra uptake by pasture plants from the soils contaminated at two different depths was investigated. Experiments were conducted in a green-house during the period of three years. Three types of soil with different contents of organic matter and two plant species (Dactylis glomerata L., Medicago sativa L.) were used. The radium derived from the soil with smallest content of organic matter is one order higher in comparison with other soils. Transfer coefficient for soil-plant system in the investigated soils and plants are given. A significant reduction of ^{226}Ra uptake with depth of radium placement was observed. (auth)

Microorganisms

7177 (AEC-tr-7512, pp 368-374) EFFECTS OF ^{90}Sr ON MICROFLORA OF WATER AND ON MINERALIZATION PROCESSES OF ORGANIC SUBSTANCES. Zhogova, V. M. 1961. Translated from Raspredelenie, Biologicheskoe Deistvie i Migratsiya Radioaktivnykh Izotopov, Moscow, Medgiz, 1961.

Experiments were conducted on the effects of ^{90}Sr and ^{90}Y on Escherichia coli, effect of ^{90}Sr on the nitrification process, and effect of ^{90}Sr on the process of self-purification of water to remove organic pollutants. In concentrations of 1.10^{-2} Ci/l or more, $^{90}Sr-^{90}Y$ retarded the rate of growth of E. coli for the first few hours of incubation only. Viability of bacterial cells was directly related to initial density of bacterial suspension and specific activity of the medium. When saline cultures of E. coli were kept for 3 months at room temperature in the presence of $1.3 \cdot 10^{-2}$ Ci/l $^{90}Sr-^{90}Y$, there was no visible effect on cultural, morphological, or biochemical properties. Nitrification processes were not influenced by concentrations at ^{90}Sr up to 10^{-2} Ci/l. (HLW)

7178 EFFECTS OF DEUTERIUM OXIDE ON BACTERIAL FLAGELLAR MOTILITY. Zipf, M. E.; Doetsch, R. N. (Univ. of

Maryland, College Park). Arch. Mikrobiol.; 92: No. 4, 321-330 (1973).

Low concentrations of ^2H_2O had either no observable influence, or a slightly stimulatory effect, on the translational movement of flagellated bacteria. High ^2H_2O levels has marked, but transient, effects, expressed as a retardation of movement, especially on peritrichous forms. Polarly flagellated bacteria rapidly recovered from ^2H_2O effects, whereas peritrichous organisms possessed only a limited recovery capacity. Flagellar regeneration and resumption of normal motion were retarded in a 1.5% (w/v) Trypticase Soy-^2H_2O medium, and again this was more evident in peritrichous bacteria. The overall length of flagella regenerated in the presence of ^2H_2O differed noticeably from those regenerated in its absence. There was no flagellar regeneration in 99.8% ^2H_2O. The morphological appearance of ^2H_2O-treated bacteria suggests that deuterium oxide acts as if it is a mild plasmolytic agent whose effects are readily reversible in most cases. (auth)

New Tracer Techniques

Refer also to abstracts 6180, 6549, 6700, 6902, 6903, 6907, 6916, 6917, 6957, 7174, and 7470.

7179 (ORO-2401-79) PARAMETER ESTIMATION IN CLINICAL NUCLEAR MEDICINE STUDIES. Brill, A. B.; Price, R. R.; Patton, J. P.; Erickson, J. J.; Ivancevic, D. (Vanderbilt Univ., Nashville, Tenn. (USA)). 1973. Contract AT(40-1)-2401. 29p. (CONF-730687-1). Dep. NTIS $4.50.

From third international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

The advent of sophisticated data acquisition systems in nuclear medicine has provided voluminous amounts of dynamic scintigraphic data. The problem at hand is the interpretation of these data into meaningful diagnostic information. A number of difficulties normally encountered in this endeavor and ways to cope with these problems are discussed. These include the use of multiple views of a radionuclide distribution for improved accuracy of quantitation; the use of simulation modelling analysis for complicated systems; and the arbitrary selection of symmetric regions of interest. (CH)

7180 THERMAL INACTIVATION OF THYROXINE-BINDING GLOBULIN FOR DIRECT RADIOIMMUNOASSAY OF TRIIODOTHYRONINE IN SERUM. Sterling, K.; Milch, P. O. (Columbia Univ., New York). J. Clin. Endocrinol. Metab.; 38: No. 5, 866-875(May 1974).

A new radioimmunoassay procedure for triiodothyronine (T_3) is described. The method uses unextracted serum at a 1:4 dilution. The novel feature of the process is that preincubation and incubation with isotope take place at 60°C. At this temperature the binding capacity of thyroxine-binding globulin (TBG) is virtually eliminated and the antigen-antibody reaction is greatly accelerated. Separation of antibody-bound hormone from free hormone is effected by polyethylene glycol solution. By plotting the standard curve on Probability × logarithmic paper, the curve is linear. Logit × log plots give the same results and facilitate calculation of data by a simple computer program. Sera of 31 normal individuals showed a mean value (±SD) of 189 ± 30 ng per 100 ml. Fourteen clinically thyrotoxic individuals had T_3 values of 838 ± 398 ng per 100 ml and 19 clinically myxedematous patients had T_3 values of 47 ± 39 ng per 100 ml. These values were confirmed by using several different antisera and by performing the radioimmunoassay on previously extracted samples. (auth)

7181 COLLOID SOLUTION OF ^{111}In FOR SCANNING THE LIVER. Tarasov, N. F.; Levin, V. L; Kozlova, M. D.; Prokof'eva, I. Sh.; Sedova, T. S.; Mirkhdzhaev, A. Kh.; Sevast'yanova, A. S. (Inst. of Biophysics, Moscow). Med. Radiol.; 19: No. 5, 8-13 (May 1974). (In Russian).

A method was developed for obtaining a new colloid solution of ^{111}In. The preparation is a colloid solution of gadolinium hydroxide (concentration of gadolinium is 0.001 mg/ml) on which carrier-free ^{111}In is sorbed. Physical characteristics of the isotope make it possible to reduce the irradiation dose of the liver down to 1.5 to 2.3 rad, i.e. by 5 to 10 times in comparison with widely used ^{198}Au colloid. The article presents the results of experimental and clinical study of the preparation. (auth)

7182 APPLICATION OF STATIC AND DYNAMIC SCINTIPHOTOGRAPHY IN THE DIAGNOSIS OF TUMORS OF KIDNEY PARENCHYMA. Kasatkin, Yu. N.; Ryabinskii, V. S.; Vidyukov, V. I.; Kulikova, N. A. Med. Radiol.; 19: No. 5, 16-21(May 1974). (In Russian).

In 27 patients with suspicion of the tumor of the kidney, a combined application of neohydrin ^{203}Hg for determining the parenchymatous function of the kidneys and ^{99m}Tc for defining the character of the vascular bed of the kidney was used. A detailed description of the method is presented. Radioisotope angiography with a combined application of two isotopes makes it possible to differentiate the tumor and cyst of the kidney. Out of 27 patients, the authors revealed tumor of the kidney in 13 patients; in 6—solitary cyst of the kidney; and in 8—the diagnosis of tumor was rejected. The use of a 4096-channel analyzer and retention of the obtained information in a videotaperecorder makes it possible to process scintigrams thoroughly. (auth)

7183 PLACENTOSCINTIGRAPHY WITH ^{113m}In. Hennig, K.; Woller, P.; Holtorff, J.; Boettger, D. (Medizinische Akademie, Dresden). Radiol. Diagn.; 13: No. 4, 555-560(1972). (In German).

The experiences with placentoscintigraphy with $^{113m}InCl_3$ with 128 pregnant women compared with former examinations with ^{99m}Tc-HSA with 126 pregnant women are reported. Based on the comparison of both nuclides with respect to their suitableness for placentoscintigraphy the use of ^{113m}In is preferred today. For the differential diagnosis of placenta praevia, deep site of the placenta, a ^{99m}Tc-source is introduced into the posterior vaginal fornix thus making a reliable localization. (auth)

7184 DETERMINATION OF THE RENAL TRANSIT TIME BY ISOTOPE NEPHROGRAM. Woller, P.; Hennig, K. (Medizinische Akademie, Dresden). Radiol. Diagn.; 13: No. 4, 561-566(1972). (In German).

For judging the drainage relations of the kidney from the isotope nephrogram several methods were already given. The kidney is considered as a black box without assumptions on the functional structure. A mean transit time can be defined giving how long on the average a hippurate molecule stays in the kidney before it leaves the kidney together with the urine. Under certain presuppositions the mean transit time can be calculated from the isotope nephrogram. The attainable accuracy is reduced by numerous factors. (auth)

7185 RADIOISOTOPE EXAMINATION OF THE RENAL FUNCTION IN PATIENTS WITH DIABETES MELLITUS. Spesivceva, V. G.; Zubovskii, G. A.; Frenkel, V. C.; Glejzer, J. T.; Kuzmin, L. N.; Mamjev, G. G. Radiol. Diagn.; 13: No. 1, 77-84(1972). (In German).

Different isotope examinations were used with diabetic patients for the determination of the functional state of the kidneys (ING with ^{131}I-Hippuran and determination of the glomerular filtration with ^{169}Yb-EDTA. Isotope nephrography was made with 52 patients; in 34 cases changes were found that mainly depended on the presence of coexistent diseases (disease of hypertension) or on a chronic pyelonephritis (as a complication of diabetes mellitus). With 50 patients the effect of the glomerular filtration was checked with ^{169}Yb-EDTA, there were decreased values in 19 cases. The authors are of the opinion that the use of ING and the isotope examination of the glomerular filtration is useful for the differential diagnosis between the chronic pyelonephritis as complication of diabetes mellitus and diabetic nephropathy (Kimmelstiel-Wilsons syndrome). (auth)

7186 ISOTOPE NEPHROGRAPHY AND SCINTIGRAPHY AS COMPLEX METHOD FOR EXAMINATION OF KIDNEY FUNCTIONS. Soskin, A. M.; Zubovskii, G. A.; Glejzer, J. J. Radiol. Diagn.; 13: No. 1, 67-75(1972). (In German).

The diagnosis of the renal function, performed in combination with isotope nephrography (ING) and functional scintigraphy using a multicrystal fast scanner (Dynapix), is reported. For the analysis of the nephrogram semiquantitative parameters are described. Both methods of examination together permit statements on the function of the renal parenchyma and on the urinary drainage; the site of functional failures may be determined topographically by means of the scintigram. Finally, a classification into 12 groups of diseases is proposed which yield typical nephrographic and functional scintigraphic results. (auth)

7187 EVALUATION OF RENAL ANGIOSCINTIGRAPHY. Haas, J. P.; Claus, H. G. (Univ., Maniz). Radiol. Diagn.; 13: No. 6, 817-823(1972). (In German).

The comparative scintigraphy with ^{131}I human serum albumin macroaggregates and angiography of more than a hundred cases are reported; partly renal scintigraphy after the intravenous administration of ^{99m}Tc iron-II-complex was made for comparison. The results of patients with renal tumors, solitary cysts, echinococcus cysts, polycystic degeneration, renal tuberculosis, hydronephrosis, chronic pyelonephritis, contracted kidneys of different etiology, dumb kidneys, blockings and stenoses of the renal arteries, "horse-shoe" kidneys, other atypical shapes, and with vascular variations are represented. It is attempted

to delimit the efficiency of renal angioscintigraphy and to show its clinical indication. Completing, confirming but also new information can be expected by it. Diagnostical failures were of technical kind, falsely positive cases scarcely occurred. (auth)

7188 METABOLIC BEHAVIOR OF ^{131}I-FALIGNOST (RADIOGRAPHIC CONTRAST MEDIA). Barke, R.; Hieckel, H. G. (Karl-Marx Univ., Lipzig). Radiol. Diagn.; 13: No. 6, 805-815(1972). (In German).

Examinations with ^{131}I-Falignost in men are reported dealing with the resorption and excretory behavior of the compound. The maximum blood concentrations after peroral application were reached between 1.5 and 5.5 hours. The most favorable x-ray time was at 5.5 hours after application. At this time 7 of 8 cholecystograms were positive and 5 primary representations of the choledochus were registered. The renal excretory portion was on an average 25.43% after 48 hours and 26.99% of the original dose after 108 hours. The results of examination show Falignost to be a rapidly resorbable oral radiographic contrast medium having a marked hepatotrophy and a concentrated liver excretion. (auth)

7189 STANDARDIZATION OF RADIOIMMUNOASSAY PROCEDURES. Report of an International Atomic Energy Agency Panel. Int. J. Appl. Radiat. Isotop.; 25: No. 4, 145-160(Apr 1974).

This report was drawn up by a panel of experts convened by the International Atomic Energy Agency in July 1972 to review the status of radioimmunoassay procedures, identify the most common problems relating to their use, and lay down guidelines relating to their standardization. Special consideration is given to the difficulties that may be encountered by workers in remote areas and those unfamiliar with the general principles of the method. General and specific problems associated with the provision of suitable reagents for radioimmunoassay, the methodology of the assays themselves, their validation, and their current and probable future applications are considered. (auth)

7190 ASSESSMENT OF FAT ABSORPTION IN MAN UTILIZING SINGLE STOOLS OR INCOMPLETE FAECAL COLLECTIONS AFTER ORAL ADMINISTRATION OF RADIOACTIVE TRIOLEIN WITH AN UNABSORBED RADIOACTIVE MARKER. Ditchburn, R. K.; Smith, A. H.; Hayter, C. J. (Leeds General Infirmary, Eng.). Int. J. Appl. Radiat. Isotop.; 25: No. 4, 167-176(Apr 1974).

The standard ^{131}I-triolein excretion test for steatorrhoea is valid only if a complete fecal collection is obtained. However, by using an unabsorbed radioactive marker that passes through the gut at the same rate as the unabsorbed radioactive triolein, a differential analysis of the relative activities of the two isotopes in an incomplete fecal collection can be used to predict the total amount of triolein excretion. Results from 33 patients showed that the degree of triolein excretion could be predicted from the ratio of the activities of ^{131}I-triolein and marker provided that the amount of marker present was at least 25% of the dose. Normal and equivocal ranges for the ratio value were established from 15 control patients. In the other 18 cases the results agreed with those obtained from the chemical fecal fat estimation (6 normal, 12 steatorrhoea). (auth)

7191 FLUORESCENT EXCITATION IN THE MEASUREMENT OF CLEARANCE OF HEAVY METALS FROM THE LUNGS. Kaufman, L.; Gamsu, G. (Univ. of California, San Francisco). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 721-725(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Measurement of the clearance of insufflated tantalum and barium sulfate powder from the lung is important in evaluating tantalum as a roentgenographic contrast agent, as well as in the investigation of lung clearance mechanisms. This report evaluates the technique of fluorescent excitation for measuring clearance of particulate tantalum and barium sulfate from the lungs, using a 2-Ci gadolinium-153 (^{153}Gd) source and an 80 mm^2 lithium-doped silicon (Si(Li)) detector. (auth)

7192 REGIONAL PULMONARY FUNCTION IN HEALTH AND DISEASE. Holman, B. L.; Lindeman, J. F. (eds.). Progress in Nuclear Medicine, Volume 3. Baltimore; University Park Press (1973). 214p. $23.50.

Separate abstracts were prepared for each of the 10 chapters. (MCG)

For abstracts of individual chapters see: 6180, and 7193–7201.

7193 REGIONAL PULMONARY FUNCTION IN HISTORICAL PERSPECTIVE. Lindeman, J. F. (St. Louis Univ.). pp 1-9 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

Studies on pulmonary function are reviewed from the time of Hook who demonstrated the necessity of air exchange for life and Harvey who demonstrated the existence of pulmonary blood flow. A review of techniques for measuring the distribution of ventilation includes the nitrogen washout curve and the use of ^{133}Xe and ^{11}C-labeled CO_2. Techniques for determining blood flow distribution in the lung include the use of cyclotron-produced radioisotopes of oxygen and carbon and ^{133}Xe. The use of ^{131}I-labeled macroaggregated human serum albumin in clinical applications of regional pulmonary function is also reviewed. (HLW)

7194 RADIOPHARMACEUTICALS FOR PERFUSION SCANNING. Davis, M. A.; Holman, B. L. (Harvard Medical School, Boston). pp 10-36 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

The use of ^{131}I-labeled macroaggregated human serum albumin for perfusion lung scanning is discussed and it is pointed out that ^{131}I has several physical properties that make it poorly suited for external imaging. The following radiopharmaceuticals are reviewed with regard to radiochemistry, toxicology, pharmacology, advantages and disadvantages; ^{99m}Tc-iron hydroxide macroaggregates, ^{99m}Tc-albumin macroaggregates, ^{99m}Tc-labeled albumin microspheres, ^{99m}Tc-sulfide-macroaggregated albumin, ^{113m}In-hydroxide macroaggregates, ^{113m}In-iron hydroxide aggregates, ^{113m}In-iron hydroxide containing albumin microspheres, and ^{67}Ga-labeled iron hydroxide macroaggregates. (HLW)

7195 RADIONUCLIDE STUDIES OF PULMONARY FUNCTION. Anatomic and Physiologic Considerations. Siegel, B. A.; Potchen, E. J. (Washington Univ., St. Louis). Contract AT(11-1)-1653. pp 49-66 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

The anatomy of the respiratory tract components and the anatomy of the pulmonary blood vessels are described. The influence of the anatomy and function of the airways on clinical radioisotope studies of pulmonary function is discussed. Mechanisms of the abnormal lung scan are discussed with regard to the distribution of regional ventilation and the distribution of regional perfusion. (HLW)

7196 ASSESSMENT OF REGIONAL PULMONARY FUNCTION WITH RADIOACTIVE GASES. Bass, H. (Harvard Medical School, Boston). pp 67-84 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

Uses of ^{133}Xe, ^{15}O, and ^{85}Kr in studies of the lungs are discussed. Topics covered include: regional distribution of blood flow through the normal lung, regional distribution of ventilation, regional gas exchange, pulmonary emphysema, chronic bronchitis, bronchiectasis, bronchial asthma, left heart failure, and pulmonary embolism. (MCG)

7197 DIAGNOSIS AND MANAGEMENT OF PULMONARY EMBOLISM. Current Status. Sasahara, A. A.; Belko, J. S.; McIntyre, K. M.; Sharma, G.V.R.K.; Morse, R. L. (Veterans Administration Hospital, West Roxbury, MA). pp 85-110 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

The preliminary diagnosis of pulmonary embolism is reviewed with regard to predisposition, differential diagnosis, clinical picture, laboratory studies, and the electrocardiogram. Special procedures reviewed are arterial oxygen tension, impedance plethysmography, lung scanning using ^{133}Xe and other radioisotopes, and pulmonary angiography. Other topics reviewed are diagnostic and therapeutic approaches to surgical therapy, and thrombolytic therapy. (HLW)

7198 PERFUSION LUNG SCAN CHANGES ASSOCIATED WITH PULMONARY EDEMA. James, A. E. Jr. (Johns Hopkins Medical Institution, Baltimore). pp 111-134 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

The records from approximately 1500 perfusion lung scans performed at the Johns Hopkins Hospital during a two-year period were reviewed. The diagnosis of uncomplicated pulmonary edema was established in 69 patients. The scans and current radiography were analyzed to determine the relation between lung scan changes, radiographic patterns, and the patients' clinical status. Perfusion defects persisted on lung scans several days after chest radiographs became normal. Perivascular edema is one hypothesis to explain the changes of radiopharmaceutical distribution. However, other physiological changes may be contributory. (MCG)

7199 REGIONAL LUNG FUNCTION IN CANCER. Fletcher, J. W.; James, A. E.; Holman, B. L. (Harvard Medical School, Boston). pp 135-148 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

A review of perfusion studies showed that the lung scan is a sensitive indicator of disease when the tumors are located near the hilum, but much less so when the tumor is in the lung periphery. It is emphasized that the role of pulmonary perfusion scanning in carcinoma of the lung must be determined in relation to other diagnostic techniques. Studies on the use of combined perfusion and ventilation for diagnosis are reviewed. Tumor-localizing radionuclides reviewed are radioactive strontium, ^{67}Ga, and ^{111}In. (HLW)

7200 SCINTILLATION CAMERA RADIOSPIROMETRY. Treves, S.; Strieder, D. J.; Adelstein, S. J. (Harvard Medical School, Boston). pp 149-165 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

The techniques for studying regional lung function with a scintillation camera are described. Data acquisition and part of the analysis are performed with a relatively simple digital videotape system interfaced to the camera. ^{133}Xe is the isotope used. Techniques, analysis, dosimetry, and interpretation are discussed. (MCG)

7201 CLINICAL APPLICATION OF COMPUTERS IN VENTILATION-PERFUSION STUDIES. Secker-Walker, R. H.; Evens, R. G. (Washington Univ., St. Louis). pp 166-193 of Regional Pulmonary Function in Health and Disease. Holman, B. L. (ed.). Baltimore; University Park Press (1973).

The scintillation detector systems used for regional pulmonary function studies are discussed. Techniques described for measuring ventilation and perfusion include: multiple probe systems, rectilinear scanning systems, gamma camera–computer systems, a gamma camera–computer–spirometer system, functional imaging, and a gamma camera and delicated computer system. Transmission gamma densigraphy and the role of digital computers in the studies are considered. Clinical applications are discussed. (MCG)

7202 ANALYSIS UNIT AND METHODS FOR ITS PRODUCTION. Glover, J. S.; Stepherd, B. P. (to Radiochemical Centre Ltd.). German (FRG) Patent 2,261,544. 12 Jul 1973. 11p. (In German).

The invention concerns studies or evaluations, by means of competing reactions of the type in which an unknown amount of a compound to be determined and a standard amount of a labelled version of the same compound compete with the reaction of a standard amount of another reagent. This method is of widespread use in the medical field for the determination of hormones and other substances. Here the antibody in immune systems or other specific reaction partners in non-immune or non-hormone systems are used as the "other reagent". (GE)

7203 DEMONSTRATION OF MYOSITIS OSSIFICANS BY ^{99m}Tc PYROPHOSPHATE BONE SCANNING. Suzuki, Y.; Hisada, K.; Takeda, M. (Kanazawa Univ. Hospital, Japan). Radiology; 111: No. 3, 663-664(Jun 1974).

A case of myositis ossificans in the right thigh is described that showed an excessive accumulation of ^{99m}Tc pyrophosphate prior to observable roentgenographic changes. Bone scanning with ^{99m}Tc pyrophosphate is very useful for the detection of soft-tissue lesions which produce extraskeletal ossification. (auth)

7204 EXPERIMENTAL PERTECHNETATE MAMMOGRAPHY. Villarreal, R. L.; Parkey, R. W.; Bonte, F. J. (Univ. of Texas, Dallas). Radiology; 111: No. 3, 657-661(Jun 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Pertechnetate mammography was tested (scintigraphy following intravenous ^{99m}Tc pertechnetate) in a group of 36 volunteers with palpable breast nodules, and diagnostic results compared with roentgen mammograms obtained for each patient. A significant incidence of false-negative pertechnetate mammograms (1 of 6 proved carcinomas) and false-positive (6 of 30 proved or presumed benign modular disease) suggests that this procedure does not fulfill requirements for a successful screening test. (auth)

7205 RUBIDIUM-81: A NEW MYOCARDIAL SCANNING AGENT. Noninvasive Regional Myocardial Perfusion Scans at Rest and Exercise and Comparison with Potassium-43. Martin, N. D.; Zaret, B. L.; McGowan, R. L.; Wells, H. P. Jr.; Flamm, M. D. (David Grant USAF Medical Center, Travis Air Force Base, CA). Radiology; 111: No. 3, 651-656(Jun 1974).

Noninvasive regional myocardial perfusion scanning at both rest and exercise was accomplished in one normal and 14 abnormal patients with arteriosclerotic heart disease using ^{81}Rb and a rectilinear scanner. All images were of diagnostic quality and compared favorably with either previous ^{43}K scans or arteriograms obtained in 11 of the 14 patients. Rubidium-81 appears to be an excellent radionuclide for myocardial imaging. (auth)

7206 THROMBOSIS DETECTION BY RADIONUCLIDE PARTICLE (MAA) ENTRAPMENT: CORRELATION WITH FIBRINOGEN UPTAKE AND VENOGRAPHY. Webber, M. M.; Pollak, E. W.; Victery, W.; Cragin, M.; Resnick, L. H.; Grollman, J. H. (Univ. of California, Los Angeles). Radiology; 111: No. 3, 645-650(Jun 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL(25 Nov 1973).

Macroaggregated albumin (MAA) entrapment in areas of fibrin deposits was used to detect intravenous thrombosis in the lower extremities. The correlation of MAA uptake in thrombosis with venography and autologous ^{125}I-labeled fibrinogen uptake in approximately 30 cases is reported. Correlation with good in most patients who underwent at least two of these procedures. The MAA thrombosis scan appears especially accurate in locating thrombosis in the upper thigh or pelvis where fibrinogen uptake is less helpful. The correlation suggests that the MAA scan has very few false negative results. The procedure is easily performed in conjunction with a perfusion lung scan. (auth)

7207 RADIONUCLIDE IMAGING IN RENAL PSEUDOTUMORS. Pollack, H. M.; Edell, S.; Morales, J. O. (Temple Univ. Health Sciences Center, Philadelphia). Radiology; 111: No. 3, 639-644(Jun 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL(25 Nov 1973).

Radionuclide renal imaging was employed in 43 patients in whom excretory urograms were suggestive, but not definite, of the presence of a renal mass. The results of the radionuclide method, performed with ^{197}Hg-chlormerodrin as the scanning agent, were compared to those of arteriography. Radionuclide imaging correctly separated the real tumors from the pseudotumors in all cases. Arteriography is rarely necessary to settle the question of true versus spurious masses raised by an equivocal urogram. (auth)

7208 DISTRIBUTION AND BEHAVIOR OF ISOSELENOURONIUM SALTS IN THE BODY. II. Possibilities of Scintigraphic Scanning the Myocardium by Means of AESe-75. Kozak, I.; Kronrad, L.; Dienstbier, Z. (Karlova Univ., Prague). Strahlentherapie; 146: No. 5, 590-593(Nov 1973).

The time course of the distribution of the ^{75}Se analogue of AET was followed in the body of the rat after i.v. administration with a view to its possible use in scintigraphical scanning of the myocardium. In the period of about 30 min after administration, the maximum cumulation was reached in the myocardium. Later, the test-compound is practically completely excreted from the body in the urine. (auth)

7209 RAPID RADIOACTIVE METHOD FOR DETERMINATION OF THIAMINASE ACTIVITY AND ITS USE IN THE DIAGNOSIS OF CEREBROCORTICAL NECROSIS IN SHEEP AND CATTLE. Edwin, E. E.; Jackman, R. (Ministry of Agriculture, Fisheries, and Food, Weybridge, Eng.). J. Sci. Food Agr.; 25: No. 4, 357-368(Apr 1974).

Methods available for the assay of thiaminase are discussed, and a new method using a liquid scintillator in a Tracer Lab Automatic Scintillation Counter and based on the cleavage of [^{14}C] thiazole-labelled thiamine is described. Due to the rapidity and simplicity of its operation, it is especially recommended when large numbers of assays need to be carried out. Its application in understanding the aetiology of cerebrocortical necrosis of cattle and sheep is reported. (auth)

7210 RADIOIMMUNOASSAY FOR SERUM AND URINE ALDOSTERONE BY CELITE COLUMN CHROMATOGRAPHY. Chadmakjian, Z. H.; Pryor, W. W.; Abraham, G. E. (Baylor Univ. Medical Center, Dallas). Anal. Lett.; 7: No. 2, 97-108 (1974).

A relatively simple and rapid radioimmunoassay (RIA) for the measurement of aldosterone in serum and urine has been developed. The method involves extraction of 1 ml of serum or urine (after acid hydrolysis) with dichloromethane, followed by partition chromatography on celite microcolumns prior to RIA. Dextran-coated charcoal is used for separation of free from antibody-bound aldosterone. The method is very sensitive,

blanks are negligible and recovery is approximately 80%. The coefficient of variation is 4.3% (within assay) and 10.4% (between assay). When known amounts of aldosterone were added to serum and urine pools containing low endogenous levels of this steroid recovery was quantitative. Aldosterone concentrations measured under various physiological conditions were in agreement with published data. Up to 150 samples can be assayed by 1 technician during 5 working days. (auth)

7211 RADIOIMMUNOASSAY OF PLASMA CORTICOSTERONE. Roy, S. K. Jr.; Garza, R.; Maroulis, G.; Abraham, G. E. (Univ. of California, Torrance). Anal. Lett.; 7: No. 2, 109-118 (1974).

This report describes a radioimmunoassay method for the measurement of unconjugated corticosterone (B) in plasma. Utilizing an anti-cortisol antiserum cross reacting with B combined with a one-step celite microcolumn chromatographic system, we have measured this latter steroid accurately in small aliquots of plasma from both male and female subjects. The plasma levels of B obtained by this method agreed well with levels observed in adult men and women, using other techniques. During a menstrual cycle studied, wide fluctuations were observed with levels ranging from 1.3 to 14.4 ng/ml. Adrenal suppression decreased the levels of B below 1 ng/ml. The mineralocorticoid B is predominantly ACTH-dependent. (auth)

7212 COMPARISON BETWEEN FOUR RADIOIMMUNOASSAYS FOR PLASMA ESTRIOL. Abraham, G. E.; Buster, J. E.; Samolik, E.; Garza, R.; Hillman, B. (Univ. of California, Torrance). Anal. Lett.; 7: No. 2, 119-123(1974).

We have compared the results obtained for plasma estriol (E_3) when four radioimmunoassay methods were used to measure this steroid during various stages of human pregnancy. The first method used a nonspecific antiserum combined with a chromatographic step. The second method utilizes as binding reagent a specific antibody against estriol combined with the same chromatographic step. The last two methods involve solvent extraction only, combined with the specific antiserum. Dichloromethane and ether respectively are used as solvent. The lowest levels of E_3 were obtained with methods I and II. With dichloromethane extraction the E_3 levels were comparable to those obtained with methods I and II. When using ether extraction the E_3 levels were in most cases two to four times higher. Even with highly specific anti-E_3 antisera, chromatography is still required to achieve specificity. (auth)

MATERIALS

7213 (PWAC-1001) ADVANCED MATERIALS PROGRAM FOR FEBRUARY AND MARCH 1962. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Apr 1962. Contract AT(30-1)-2789. 40p. Dep. NTIS $4.00.

Declassified 20 Sep 1973.

Research is reported on materials and fuels for high-temperature liquid metal-cooled reactors: tensile properties, oxidation, and coating of Nb-base alloys; production, compatibility, thermal expansion, evaporation, and irradiation testing of U carbide; synthesis of UC–ZrC; electric conductivity of Na; and evaluation of UN–Nb cermet (irradiation, compatibility). (DLC)

7214 (PWAC-1002) ADVANCED MATERIALS PROGRAM FOR APRIL AND MAY 1962. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 28 Jun 1962. Contract AT(30-1)-2789. 47p. Dep. NTIS $4.50.

Declassified 20 Sep 1973.

Materials and fuels for high-temperature liquid metal-cooled reactors were studied: mechanical properties, oxidation, and coating of Nb-base alloys (containing W, Zr, and other additives); production, evaporation, compatibility, and irradiation testing of UC; electric conductivity of Cs; and irradiation testing of Nb–UN cermet. (DLC)

7215 (PWAC-1004) ADVANCED MATERIALS PROGRAM FOR JULY AND AUGUST 1962. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 19 Oct 1962. Contract AT(30-1)-2789. 39p. Dep. NTIS $4.00.

Declassified 20 Sep 1973.

Materials and fuels for high-temperature liquid metal-cooled reactors were studied: development of structural Nb-base alloys; mechanical properties of Nb–Zr–C dispersion alloys; development of carbide and nitride fuels; and solubility of He in K. (DLC)

7216 (PWAC-1005) ADVANCED MATERIALS PROGRAM FOR SEPTEMBER AND OCTOBER 1962. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 14 Dec 1962. Contract AT(30-1)-2789. 44p. Dep. NTIS $4.25.

Declassified 5 Sep 1973.

Research is reported on materials and fuels for high-temperature liquid metal-cooled reactors: mechanical properties of Nb–5Mo–3Ti–3Zr; dispersion strengthening of Nb–Zr–C; silicide coating of Nb against oxidation; development of carbide and nitride fuels; and solubility He and Mo in K. (DLC)

7217 (PWAC-1006) ADVANCED MATERIALS PROGRAM FOR NOVEMBER AND DECEMBER 1962. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Jan 1963. Contract AT(30-1)-2789. 50p. Dep. NTIS $4.50.

Declassified 5 Sep 1973.

Fabrication and properties of Nb-base alloys containing Mo–Ti–Zr, W–Ti–Mo, and Ta–Zr–C were studied. Strength, microstructure, and testing of dispersion-strengthened Nb–Zr–C alloys were determined. The mechanism of oxidation protection by silicide and aluminide coatings was studied. Development of carbide and nitride fuels for high-temperature liquid metal-cooled reactors continued, including compatibility tests, hot hardness of U carbide, and N_2 pressure over UN. Additional data were obtained on the solubility of He in K, and of Mo in K and Li. (DLC)

7218 (PWAC-1007) ADVANCED MATERIALS PROGRAM FOR JANUARY AND FEBRUARY 1963. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 19 Apr 1963. Contract AT(30-1)-2789. 60p. Dep. NTIS $5.00.

Declassified 5 Sep 1973.

Preliminary strength tests of Nb–5 Mo–3 Ti–3 Zr alloy at 2000°F indicated a stress rupture strength about double that of Nb–1 Zr alloy. This alloy and Nb–10 W–6 Ti–4 Mo were fabricated without difficulty. The yield strength of Nb–12 Ta–3 Zr–0.33 C was increased 95% by double extrusion. Nb–3 Zr–0.3 C alloy showed a rupture strength at 2400°F about five times higher than that of Nb–1 Zr. The deleterious effect of cold reduction on the strength of this alloy was eliminated by solution heat treatment. The recrystallization characteristics of the Nb–3 Zr–0.3 C alloy were determined. Y was found to be highly effective in the deoxidation of Nb–Zr–C during melting. Reprocessing did not improve the performance of a pack-deposited silicon coating. Preliminary tests were made with the plasma-anode diode. Tests of uranium carbide under the SNAP-50 reactor program indicated either swelling or excessive gas release at 2200°F. Hyperstoichiometric carbon was ineffective in suppressing reactions with Nb–1 Zr alloy at 2200°F. Heat content of uranium nitride was established. Irradiation tests conducted at 2100°F for 1000 hours showed no anomalies. Techniques were developed for the fabrication of high density UN–W cermets with up to 60 vol % UN. Nitrogen pressures over UN were determined at temperatures up to 3600°F. The solubility of He in K was shown to obey Henry's law. Initial data for the solubility of Nb in Li confirmed extrapolated numbers. Data are given on the effects of O on Mo solubility in K. (DLC)

7219 (PWAC-1008) ADVANCED MATERIALS PROGRAM FOR MARCH AND APRIL 1963. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 10 Jul 1963. Contract AT(30-1)-2789. 68p. Dep. NTIS $5.50.

Declassified 5 Sep 1973.

In preliminary tests the rupture strength of extruded Nb–5 Mo–3 Ti–3 Zr alloy was twice that of Nb–1 Zr alloy at 1100°C. Forgings and extrusions of Nb–10 W–6 Ti–4 Mo alloy were cold-rolled and swaged successfully. Alloys Nb–15 W–3 Hf–0.5 C and Nb–14 W–3 Zr–0.5 C each exhibited a yield strength of 30,000 psi at 1315°C. Strength data was correlated with metallographic characteristics for PW-33 Nb–3 Zr–0.3 C) alloys. Microcracks in protective coatings were not filled by successive pack-siliciding. A reliability test on SnAl–35 slurry coating for Nb–1 Zr alloy showed this treatment to be 95.5% reliable in a 1000-hour test at 540°C. Preliminary measurements of thermal conductivity of hot-pressed uranium carbide were made in the range 680 to 1400°C. Gas release from irradiated uranium carbide was shown to vary inversely with density; swelling varied directly with density. The equilibrium solubility of molybdenum in purified potassium and lithium was below the limit of detectability. Additions of oxygen to potassium resulted in an appreciable increase in the apparent molybdenum solubility. Samples of welded Nb–5 Mo–3 Ti–3 Zr alloy, exposed to 1100°C potassium for 330 hours, showed no indication of surface layer or attack. (auth)

7220 (PWAC-1009) ADVANCED MATERIALS PROGRAM FOR MAY AND JUNE 1963. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 6 Aug 1963. Contract AT(30-1)-2789. 58p. Dep. NTIS $5.00.

Declassified 5 Sep 1973.

Further testing of the PWC-533 alloy has confirmed that cold work causes elevated temperature strength reductions. PWC-1064 and T-111 alloys were forged at high temperatures, cold-rolled, and cold swaged. Ternary and binary alloys were tested under a 9000 psi stress load at high temperatures. Cold sprayed and fired nickel-silicon was found effective in filling microcracks in pack-deposited silicide coatings. Preparations have been made for further testing of a silicide coating deposited in the presence of molten magnesium. Hyperstoichiometric uranium carbide and unlined Nb–1 Zr alloy pins have been found to be incompatible at 1200°C. A one-mil tungsten foil barrier has completely prevented reactions between stoichiometric UC and Nb–1 Zr alloy for 5000 hours at 1200°C. Thirty-five mil Nb–1 Zr alloy clad UN irradiation specimens displayed 0.4 to 0.8 percent diameter swelling after 1690 hours at 1175°C. Pellets of UC–90 mole percent ZrC were hot pressed, ground to size and encapsulated for the first 1950°C inpile experiment. Thermodynamic quantities for UC were recalculated on the basis of new data. A tantalum carbide Knudsen cell was fabricated. Preliminary values for the viscosity of potassium have been obtained up to 567°C. The apparent solubility of molybdenum in potassium was found to be directly dependent upon oxygen concentration. The correlation was not significantly altered by the use of additives introduced by nitrogen and carbon with the oxygen. Two ultra-high vacuum chambers for testing structural metal alloys with liquid metals have been assembled. One is being tested prior to operation. Nb–5 Mo–3 Ti–3 Zr corrosion specimens in Nb–1 Zr alloy capsules were examined after 1600 hours in 1100°C potassium. Results of metallographic examination indicated no attack or surface layers in the as-welded, heat affected or base metal areas of either alloy. (auth)

7221 (PWAC-1010) ADVANCED MATERIALS PROGRAM FOR JULY AND AUGUST 1963. (Pratt and Whitney Aircraft,

Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 25 Oct 1963. Contract AT(30-1)-2789. 76p. Dep. NTIS $6.00.

Declassified 5 Sep 1973.

The yield strength at 1100°C of cold-rolled PWC-533 sheet was increased 50 percent by a 1650°C solution heat treatment. WC-11 alloy exhibited better stress-rupture strength at 1100°C than did low carbon Nb–1 Zr alloy. Nb–10 W–3 Hf–0.4 C alloy was forged and rolled to sheet. Mechanical property studies of Nb–3 ZrC alloys in comparable fabricated conditions indicate that increasing carbide concentrations improved yield strengths at 1315°C. Results of release analyses of sintered UC irradiation data indicate porosity is not interconnected in material exceeding 95 percent theoretical density. A 1-mil tungsten barrier proved effective for UC/Nb–1 Zr alloy after 6000 hours at 1205°C. Anomalies were observed in 5000-hour testing of 1-mil tungsten as a barrier for UN/Nb–1 Zr alloy interaction. Fuel pin fabrication for the 1950°C inpile experiment was completed. A linear relationship between apparent solubility of molybdenum and oxygen content of potassium was verified for oxygen additions up to 5000 ppM in 1095°C potassium. Performance tests demonstrated that the first ultra-high vacuum system was acceptable. A Nb–1 Zr alloy loop was filled with potassium, seal-welded and instrumented. Ni–Si coatings as microcrack sealants demonstrated improved composite durability at 2000°F in air. (auth)

7222 (PWAC-1011) ADVANCED MATERIALS PROGRAM FOR SEPTEMBER AND OCTOBER 1963. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Dec 1963. Contract AT(30-1)-2789. 62p. Dep. NTIS $5.25.

Declassified 6 Sep 1973.

Test results continue to demonstrate the effectiveness of fine carbide dispersion as a strengthening agent, especially when double extruded in certain alloys. Annealing studies of cold worked T-111 alloys were conducted to determine thermal treatments for stress relief annealing and recrystallization. Initial grain growth occurred upon heating from 1540 to 1980°C. Nb–1 Zr alloy and Nb–1 Zr–Y alloy sheet welds which were made using Nb–1 Zr–1 Y alloy filler had low weld bead oxygen content and were ductile when aged. As-welded T-111 exhibited limited ductility, which was restored by annealing at 1200°C. Results of strength evaluation at 870°C of titanium alloys indicated several beta alloys were not as strong as desired, whereas an alpha alloy appeared promising. Further analysis of the microstructure of fuel irradiation specimens shows swelling to be associated with growth of intergranular voids. Compatibility results of uranium carbide versus improved, high-strength alloys indicate reactions similar to UC versus Nb–1 Zr alloy. Results of testing with a tantalum barrier indicated depletion of carbide precipitates and formation of a carbide layer, presumably due to iron impurities. Construction and testing of the thermal diffusion apparatus were completed. Uranium nitride decomposition data, obtained using a tantalum carbide Knudsen cell, showed higher evaporation rate than the value obtained using tantalum and tungsten cells. Modifications were made to the plasma-anode diode, resulting in more reproducible emission measurement. The linear relationship between apparent solubility of molybdenum and oxygen content of potassium was verified for oxygen additions as KO_2, KNO_3, and K_2CO_3 up to 5000 ppM in 1095°C potassium. Additional data further confirmed the temperature independence of molybdenum solubility at the 500 ppM oxygen addition level in the 650 to 1095°C range. A Nb–1 Zr alloy loop containing boiling potassium has accumulated 200 test hours at operating conditions of 1070°C boiler liquid, 1010°C hot isothermal section vapor, and 815°C condenser exit in a vacuum of 2.5×10^{-8} torr. Slurry coating uniformity and efficiency were increased by the use of magnesium–calcium alloy as the transitory liquid metal diffusion and reaction activator phase. (auth)

7223 (PWAC-1012) ADVANCED MATERIALS PROGRAM FOR NOVEMBER AND DECEMBER 1963. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 21 Feb 1964. Contract AT(30-1)-2789. 60p. Dep. NTIS $5.00.

Declassified 6 Sep 1973.

Additional high temperature stress rupture data on the Nb–1 Zr–0.1 C (PWC-11) alloy confirmed strength superiority over Nb–1 Zr alloy reported previously. This alloy displayed excellent bend ductility at room temperature in the as-welded condition or as annealed at temperatures of 1205°C and above. Improved extrusion and rolling practices were developed. Studies of the carbide phases in niobium–zirconium–carbon alloys as a function of thermal history and composition provided additional insight into the basic phase relationships. Metallographic studies of irradiated UC fuel samples disclosed several apparent correlations of phase transformations with fission gas release and agglomeration. The $U_2C_3 \rightarrow$ UC transformation appears to be particularly important to the determination of the irradiated microstructure. The effectiveness of tungsten as a diffusion barrier between niobium alloy and UC was further substantiated by an 8000-hour, 1200°C test. No significant tungsten–niobium interdiffusion was observed on couples heated at 1200°C for 400 hours. The room temperature hardness of UC was increased from 650 to 910 dph by the addition of less than two weight percent tungsten. Good agreement was noted in the thermal conductivity of UC as measured in vacuum and in argon. Additional information was established to demonstrate the effect of density on conductivity. Uranium nitride showed no appreciable reaction with tungsten in a 3500 hour test at 1200°C. A 60 vol % UC–W cermet was hot pressed at 1800 to 1950°C to 98 percent of theoretical density. A 70 volume percent UO_2–W cermet was hot pressed at 2205°C to 88 percent theoretical density. The initial tungsten coated UO_2 particles showed appreciable porosity. The validity of the UC vaporization data was supported by a successful check of the Langmuir evaporation rig, using molybdenum as a standard. Analytical chemical techniques were confirmed for the determination of small concentrations of niobium in lithium and potassium. The boiling potassium Nb–1 Zr alloy loop reached 1655 hours of operation at 1070°C at pressures of 2.5×10^{-8} torr. The PWC-533 (Nb–5 Mo–3 Ti–3 Zr) loop attained 993 hours at 1095°C. No operational troubles have been experienced. A number of refractory metals and alloys and ceramic materials showed satisfactory compatibility with 870°C cesium vapor at 5 torr pressure in a 300 hour test. Tests at 1370°C were initiated. Preliminary internal friction tests indicated that interstitial oxygen in PWC-33 alloy (Nb–3 Zr–0.3 C) responds to thermal treatment in a manner similar to Nb–1 Zr alloy. Migration of chromium and nickel in dispersed phase silicide slurry coatings was shown by microbeam probe analyses. Intermetallic chromium compounds improved the stability of the dispersed constituents. Titanium hydride was used successfully for the slurry titanizing of Nb–1 Zr alloy. (auth)

7224 (PWAC-1013) ADVANCED MATERIALS PROGRAM FOR JANUARY AND FEBRUARY 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 15 Apr 1964. Contract AT(30-1)-2789. 62p. Dep. NTIS $5.25.

Declassified 6 Sep 1973.

The effects of working temperature and heat treatment on the properties of PWC-11 alloy were further investigated. The elevated temperature strength of cold-rolled PWC-33 alloy sheet was markedly improved through solution heat treatment. Strength levels comparable with hot-forged material were attained. Nb–1 Zr alloy welds made with Nb–1 Zr–2 Y filler wire did not exhibit aging embrittlement comparable with Nb–1 Zr alloy filler welds. Preliminary tests were made on a number of alpha and beta titanium alloys to determine the effect of carbon additions. Data indicate best dispersion strength properties are developed when zirconium and carbon contents are atomically equivalent. Stoichiometric uranium carbide and Nb–1 Zr with a 1-mil tungsten barrier interposed show no reactions after 9000 hours at 1205°C. Hypostoichiometric UC in contact with a 1-mil tungsten foil backed by PWC-11 and -33 alloys showed considerable reaction after 548 hours at 1205°C. Fabrication parameters necessary to produce high density, homogeneous UC–1 wt % W fuel compacts were determined. The thermal diffusion apparatus was modified to allow higher specimen temperatures and three specimens were run. The electrical resistivity of two specimens of UC and one of ZrC was determined over the temperature interval 30 to 1300°C. A model which explains swelling and gas release observed in UC fuels is described. Fabrication parameters necessary for producing high quality UN thermal conductivity specimens were determined. Development of processes to make spherical particles of UN and UC were continued. Results of plasma spraying studies show that UN decomposition during melting is difficult to control under available conditions. The partial pressures of uranium and monatomic carbon or triatomic carbon were calculated for the weight loss data reported last period. Values of the standard heat of formation of UC were computed using alternate values of the entropy of $UC_{1-\delta}$ and the heat of vaporization of uranium. The standard heat of formation of UN was calculated from Knudsen data obtained using cells of tungsten, tantalum, and tantalum carbide. The partial pressure of uranium over UN was recalculated from previous data applying temperature and non-ideal-orifice corrections. Final modifications to the plasma anode discharge tube resulted in highly improved performance. Preliminary analysis of emission data for tungsten and W–5 Re yielded work functions of 4.52 ± 0.02 and 4.64, respectively. An Arrhenius-type temperature dependence was observed for the apparent solubility of molybdenum in potassium with 500 ppM of added oxygen over the temperature range of 260 to 600°C. Analysis of molybdenum after exposure to contaminated potassium showed dif-

ferences in corrosion behavior dependent upon the contaminants present. A Nb–1 Zr alloy loop containing boiling potassium (1070°C) has completed 3000 hours of continuous operation at essentially stable boiling conditions in an average vacuum of 2.5×10^{-6} torr. A PWC-533 alloy loop containing boiling potassium (1095°C) accumulated 2373 hours of continuous operation at stable boiling conditions in an average vacuum of 6.5×10^{-9} torr. Operation has been interrupted to allow repair of a heater electrode water coolant circuit external to the vacuum chamber. Samples of ZrO_2–$8Y_2O_3$ ceramic exposed to 870°C cesium vapor showed grain-boundary penetration and loss of strength. Compatibility tests of refractory metals and ceramic materials in 1370°C cesium vapor were completed and post-test examinations initiated. Preliminary internal friction peaks have been obtained for unalloyed tantalum and Ta–9.0 W specimens. Refinement of inoculation techniques have been instituted in order to improve agreement between calculated and analyzed oxygen values present in inoculated specimens. A magnesium–calcium alloy was shown to be effective as a transitory liquid metal medium for slurry deposition of silicon and $NbCr_2$ combinations but not for titanium–chromium combinations. The titanium hydride slurry coating technique was successfully applied to the deposition of titanium–niobium–chromium layers on titanized Nb–1 Zr alloy. (auth)

7225 (PWAC-1014) ADVANCED MATERIALS PROGRAM FOR MARCH AND APRIL 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 15 Jun 1964. Contract AT(30-1)-2789. 78p. Dep. NTIS $6.00.

Declassified 6 Sep 1973.

The effects of working temperatures and heat treatment on the structure and strength of PWC-11 and PWC-33 were further investigated. Testing of alpha titanium alloys containing 5 to 7 percent aluminum and 0.4 to 0.6 percent carbon has shown good rupture strength at 650°C. Microstructures and hardness properties of Nb binary and ternary alloys were examined. Carbide phases of these alloys were identified and the structural changes caused by heat treatment noted. Results of a study of the interdiffusion of Nb–1 Zr alloy and tungsten showed that an interdiffusion zone approximately 0.02 cm is expected after 10,000 hours at 1200°C. Partial depletion of U_2C_3, presumably by thermal diffusion, occurred at the hot surface after exposing a hyperstoichiometric UC sample to a temperature gradient of 69°C/mm (1515 ID, 1095 OD). Thermal conductivity and electrical resistivity measurements of UC specimens are sensitive to compositional variations and nitrogen and oxygen impurity content. End pellets in an irradiated fuel stack which are unrestrained axially display the greatest amount of interconnnected porosity. A program was initiated to determine the self-diffusion coefficient for nitrogen in uranium mononitride, using the isotope exchange technique. The dependence of irradiation swelling as measured by density change with burnup is practically linear for UN under the conditions studied. In general, fission gas release for a given density change is higher for UN than for UC. The microstructures of UC–W alloys were investigated by electron metallography and electron microbeam probe. Hot-hardness values for a number of UC–W alloys are reported. Spheroidized uranium nitride containing free uranium was subjected to heat treatment in nitrogen atmospheres to replace lost nitrogen. An attempt was made to measure the vapor pressure of pure uranium using a tantalum carbide Knudsen cell. A linear least squares equation describing the pressure of nitrogen over $UN_{(s)}$ as a function of temperature was calculated from 58 data points. A preliminary evaluation of the feasibility of conducting Knudsen effusion experiments on $UC_{1.x(s)}$ was made. A number of determinations were made of the average work functions of tungsten, W–5 Re, W–26 Re and pure rhenium wire specimens using the plasma anode diode technique. Values for tungsten and rhenium fall within three percent of the accepted literature values. Both W–5 Re and W–26 Re showed apparent work functions lower than either tungsten or rhenium. The solubility of niobium in lithium was found to be 25 to 130 ppM from 760 to 1425°C with no temperature dependent pattern observable. Additions of up to 5000 ppM nitrogen, as Li_3N and up to 10,000 ppM oxygen as Li_2O, did not appear to influence the equilibrium niobium solubility. Post-test visual examination of the boiling potassium Nb–1 Zr alloy loop operated for 3000 hours (1070°C) showed no indication of deposits or layers on any interior surfaces. Weight losses of Nb–1 Zr alloy corrosion specimens were equivalent to 0.06 mils wall-thinning in the condenser and 0.003 mils wall-thinning in the boiler. Results of post-test chemical analyses indicated that the oxygen content of potassium decreased as a result of test conditions and that in the high vacuum environment oxygen, carbon, and nitrogen contamination of refractory metal surfaces was negligible. The Nb–5 Mo–3 Ti–3 Zr alloy (PWC-533) loop containing boiling potassium (1095°C) has successfully completed 3000 hours of continuous operation at stable boiling conditions in an average vacuum of 5×10^{-9} torr. Selected metals and ceramic insulator materials were exposed in 1370°C cesium vapor at a pressure of 5 torr for 300 hours. Results of post-test evaluation indicate that the effect of cesium vapor on all tested materials was negligible. Internal friction measurements have been performed on wire specimens of Ta–9.0 W alloy and a correlation of peak height with oxygen concentration has been observed. Preliminary internal friction measurements were initiated for Ta–8.0 W–2.0 Hf alloy. Wire specimens of Ta–9.0 W and Ta–8.0 W–2.0 Hf have been encapsulated and exposed to lithium. A design for a vacuum torsion pendulum was initiated. X-ray diffraction studies of the niobium–titanium–chromium layer of a slurry-deposited titanium–chromium–silicon coatings were completed. Attempts to deposit a niobium disilicide overcoating on PWK-35 coated Nb–1 Zr alloy were continued. Work was initiated on the deposition of niobium silicide undercoatings for PWK-35 coated Nb–1 Zr alloy in order to improve coating durability at higher temperatures. (auth)

7226 (PWAC-1015) ADVANCED MATERIALS PROGRAM FOR MAY AND JUNE 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 17 Aug 1964. Contract AT(30-1)-2789. 60p. Dep. NTIS $5.00.

Work has been concluded on strength improvement of niobium base alloys. Further evaluation of PWC-11 alloy will be done on the SNAP-50/SPUR program. Alpha titanium alloys in the titanium–aluminum–carbon system continue to show promise for use at 650°C. Additional baseline tensile and rupture data were generated on three binary NbC alloys to supplement studies of the more complex ternary and quaternary NbC base alloys. The systematic program for the establishment of the ternary niobium–zirconium–carbon phase diagram is continuing. Preliminary creep data on $UC_{1.1}$ was obtained. Electron metallographic studies were initiated on post-irradiation UC fuel. A literature survey of gas atom and gas bubble diffusion was started. Fine dispersions of a stable second phase appear to significantly affect nucleation and growth of gas bubbles. A particle density of 10^{14}/cubic centimeter appears about optimum. Construction of the experimental apparatus for determining nitrogen self-diffusion in UN is nearing completion. Estimates were made for times necessary for experimental runs. A study of the effect of nitrogen pressure and specimen temperature on plasma discharges within the specimen chamber was carried out. A microstructural review of irradiated UN has qualitatively substantiated a hypothesis to account for greater release in UC than in UN. A short review of UN–W cermet development in FY-1964 is given. A process to replace nitrogen lost in plasma spheroidizing of UN was developed which results in single phase, spherical UN particles of high density. A pure nitrogen plasma, used for the first time, did not eliminate the decomposition of UN. The rate of evaporation of a tungsten-coated uranium nitride pellet was measured by the Langmuir evaporation technique. The vapor pressure of pure uranium was measured by Knudsen effusion. Work functions determined by plasma diode show decreasing work function with increasing rhenium content in tungsten–rhenium alloys up to 25 wt % rhenium. A short review of this program is included. The program has been terminated. The solubility of niobium in lithium was measured over the temperature range of 760 to 1540°C, and a temperature coefficient was estimated from averaged data. Additions of lithium nitride and lithium oxide to lithium had no detectable effect on niobium solubility under the conditions tested. Preliminary results in the study of solubility in the niobium–potassium–oxygen system at 1095°C showed no oxygen dependence up to 3000 ppM, but a significant increase at 5000 ppM. Post-test metallographic examination of the Nb–1 Zr alloy loop containing 1070°C boiling potassium for 3000 hours indicated no appreciable attack or contamination of wrought or welded sections. Chemical analysis of loop sections indicated that oxygen and zirconium concentrations increased somewhat in the condenser and carbon increased in the boiler and condenser. Room temperature bend tests of welds from boiler, hot isothermal, and preheat sections of the loop indicated no adverse effects on ductility. Comparison of tensile test results for Nb–5 Mo–3 Ti–3 Zr alloy (PWC-533) specimens exposed to potassium, and for thermal control specimens exposed to argon indicated no mechanical property changes. A limited effort was applied to evaluation of ceramic insulator materials and to design of test equipment. Lithium compatibility of oxygenated Ta–8 W–2 Hf and Nb–1 Zr–0.1 C alloy specimens could be correlated with oxygen associated internal friction peaks. Results, in general, were consistent with corrosion model developed for Nb–1 Zr alloy. X-ray diffraction and electron microbeam probe studies of the niobium–titanium–chromium layer of a slurry deposited titanium–chromium–silicon coating were completed. A coating composition designated PWK-5 consisting of a niobium

disilicide diffusion barrier layer with a niobium–aluminum–tin overlayer (niobium modified PWC-35) was developed. (auth)

7227 (PWAC-1016) ADVANCED MATERIALS PROGRAM FOR JULY AND AUGUST 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 11 Nov 1964. Contract AT(30-1)-2789. 69p. Dep. NTIS $5.50.

Declassified 20 Sep 1973.

Experimental work has continued in an effort to develop a titanium-base alloy equivalent in strength at 650°C to austenitic stainless steel and with sufficient room temperature ductility to permit fabrication into mill products by conventional methods. Construction of the experimental apparatus for determining the self-diffusion coefficient of nitrogen in uranium nitride has been completed and the volume has been calibrated. Oxygen exists as a finely-dispersed precipitate (>10^{15} particles/cm^3) in sintered UN. The dispersion is stable for long periods (3000 hours) at 1250°C out-of-pile, but agglomerates (10^{11} particles/cm^3) in 660 hours inpile at 1220 to 1300°C. The thermal conductivity of a high density, UC specimen was measured in the temperature range 1000 to 1500°C and compared with previous results. Nitrogen and oxygen impurities lower the thermal conductivity as much as 10 to 20 percent in this temperature range. A molybdenum standard was tested and the results agreed with literature values. A UN thermal conductivity specimen was fabricated by hot-pressing and was machined. A fourth compressive creep test on uranium carbide showed a creep rate of 3.14×10^{-4}/in./hr at 1300°C and 8000 psi. A 36 percent deformation of uranium carbide at 1120°C followed by an anneal at 1593°C for one hour produced 100 percent recrystallization. Annealing at 1538°C after 50 percent deformation at 1204°C also produced complete recrystallization. An analysis of UC and UN irradiation data has led to the conclusions that small gas bubbles are retained transgranularly in UN, but not in UC. This has been verified by electron microscopy. Uranium nitride spheres have been produced using a plasma flame and renitriding in a furnace. Uranium nitride cermets containing 40, 50, 60 vol % UN have been fabricated to densities of approximately 90 percent of theoretical by hot-pressing. A UC–W cermet containing 90 vol % UC was hot-pressed from tungsten-coated UC particles, and appeared to have a discontinuous UC phase. Chemical analyses of PWC-533 alloy loop sections after 3000-hour exposure to boiling potassium showed no significant changes. Metallographic examination indicated complete compatibility of the alloy in potassium under test conditions. Elevated temperature tensile test specimens of PWC-533 alloy from boiler liquid, boiler vapor, and condenser vapor and liquid were comparable to argon exposed thermal control specimens. PWC-11 alloy corrosion and mechanical property specimens completed 3000 hours in a Nb–1 Zr alloy loop containing boiling potassium. Additional metallographic and oxidation protection evaluations verified that the composite silicide–aluminide PWK-5 coating was most promising for service in high temperature air. Coating lifetimes in 1100°C air were consistently greater than 500 hours and were unaffected by moderate variation in weights of individual layers. Substitution of tantalum or chromium for niobium in the second layer of PWK-5 coating did not improve performance. Analysis of results on dispersed phase coatings of titanium–chromium–silicon indicated that an improved slurry coating sequence is required in order to increase the (Nb, Ti) Cr_2 layer. Free energies of formation were calculated for several refractory metal carbides from 1000 to 2000°C. A detailed internal friction study of heat treat response of the oxygen stabilizing reaction in Nb–1 Zr alloy was initiated. Additional evidence from lithium compatibility tests and internal friction studies indicates that Nb–Zr–O corrosion model is generally applicable to the Ta–W–Hf–O system. Compatibility tests were initiated to determine interdiffusion of potentially useful radiator materials as a function of time and temperature. Initial joining data was established. Grain coarsening characteristics were determined at braze temperatures. (auth)

7228 (PWAC-1017) ADVANCED MATERIALS PROGRAM FOR SEPTEMBER AND OCTOBER 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 17 Dec 1964. Contract AT(30-1)-2789. 78p. Dep. NTIS $6.00.

Declassified 6 Sep 1973.

A number of niobium–zirconium–carbon compositions were melted, the vacuum quench rig was put into operation, and metal-carbide diffusion couples were studied to determine reaction rates and phase compositions. The room temperature ductility of titanium–aluminum–carbon alloys was improved by the addition of boron and niobium. Despite this, low room temperature ductility is still the major problem in the development of the high strength base-high temperature alloy. Acid and cathodic etches were used to identify UO_2 precipitates in UN. The results support previous data reported in PWAC-1016. Experiments were conducted to study the agglomeration of the second phase precipitate. The self-diffusion coefficient for nitrogen in uranium nitride was tentatively determined to be 9.2×10^{-11} cm^2/s at 1370°C. Carbon x-ray analysis of UC, U_2C_3, and UC_2 has been demonstrated using a microprobe. The thermal conductivity of hot-pressed uranium nitride was measured. Results at 1010 and 1370°C were 0.254 and 0.268 watts/cm-°C, respectively. Electrical resistivity measurements of UC were continued. An activation energy for creep of uranium carbide was measured by the rapid change in temperature method. At 1200 to 1250°C, 6000 psi stress, an activation energy of 44 kcal/mole was calculated. Uranium carbide, deformed at 1093°C to 50 percent reduction in height, showed significant degree of preferred orientation as determined by x-ray diffraction. An apparent effect of oxygen content on the recrystallization behavior was noted for uranium nitride deformed to 62 percent reduction in height. A review of gas release data from irradiation hyperstoichiometric uranium carbide capsules suggests a relationship which may enable prediction of xenon release under certain limitations. Progress was made on helium and xenon bombardment of uranium carbide. The most favorable condition for electron metallography was obtained with helium. It was shown that inert gas concentrations equivalent to six percent burnup could be established in a surface layer 500 Angstroms thick. A process was developed for the production of coarse particle uranium nitride by direct synthesis of uranium metal. A laminar helium plasma flame produced greater than 90 percent spherical UN. The particle density was in excess of 90 percent, but only about 40 percent of the product was within the desired particle size range. Tungsten-coated uranium carbide was hot-pressed to high densities with a discontinuous uranium carbide phase. Preliminary compatibility data was obtained for PWC-11 alloy specimens after 3000 hours in a 1080°C boiling potassium loop fabricated from Nb–1 Zr alloy. Wall thinning calculated from weight loss measurements was negligible. Work was initiated toward a test of T-222 alloy in 1430°C lithium and Mo–TZM AS–30, and PWC-188 alloys, and bearing materials, in boiling potassium. Quantitative measurements of the interaction between aluminide coatings and niobium base alloys at 1100°C for periods to 2500 hours were completed. The distribution of the coating elements in the as-formed PWK-5 coating was determined and the optimum addition of Nb to the PWK-5 coating established. Preliminary data was obtained for the interaction kinetics in the Nb–1 Zr–O system at 1093°C for up to 135 minutes. A Ta–8 W–2 Hf specimen previously heat-treated at 1600 and 1300°C exhibited excellent compatibility in 1000°C lithium. Further verification of the effectiveness of helium as an oxygen scavenger in tantalum alloys was obtained from internal friction studies. Tests were initiated to measure carbon transport from niobium–zirconium–carbon alloys across lithium filled gaps of varying breadth. Preliminary data were obtained concerning the stability of carbon containing species added to lithium. A majority of the 100-hour and 800-hour compatibility tests were completed. Brittle intermetallics were formed on aging of beryllium–niobium alloy and beryllium–stainless steel joints brazed with pure silver. A number of other brazed alloys were evaluated for joining beryllium to stainless steel and niobium alloy. Silicon was successfully plated on beryllium as a possible diffusion barrier. (auth)

Ceramics and Cermets

Refer also to abstracts 5957, 6194, 7403, 7503, and 7938.

7229 (AD-763237) MANUFACTURING METHOD FOR IMPROVED FORMING OF BORON CARBIDE. Vasilos, T. (Avco Corp., Lowell, Mass. (USA). Systems Div.). Jun 1973. Contract DAAG46-72-C-0216. 28p. (AMMRC-CTR-73-21). NTIS $3.00.

Boron carbide in the form of 12 in. × 12 in. × 3/8 in. thickness was hot pressed to a density of >98% of theoretical by alloying additions at a temperature of 1750°C and a pressure of 3500 psi. Chemical analysis reveals iron as the principal densification aid remaining in the hot-pressed structure. Transverse rupture and elastic modulus tests were conducted on samples 1 3/4 in. × 1/4 in. × 0.100 in. cut from a 12 in. × 12 in. tile. The data show the rupture strength decreasing from an average of 73.4 ksi at room temperature to an average of 38.4 ksi at 1400°C. The elastic modulus decreases from 55.5×10^6 psi at room temperature to 35.5×10^6 psi at 1200°C. Hardness measurements taken with a Knoop indenter (100 gm load) range from 2530 to 2670. (auth)

7230 (AD-768073) IRRADIATION EFFECTS IN Pb–Sn–Te. Annual Report, 1 August 1972–31 July 1973. Colwell, J. F.; Green, B. A.; Harper, H. W.; Leadon, R. E.; Naber, J. A. (Intelcom Rad Tech, San Diego, Calif. (USA)). 17 Aug 1973. Contract N00014-73-C-0013. 74p. (RT-8040-1). NTIS $3.50.

The electrical properties of Pb(1-x)Sn(x)Te have been measured before and after irradiation and during isochronal annealing after irradiation for samples with a nominal value of x = 0.2 and different initial hole densities. For two samples that were initially degenerate at 78°K, the hole density decreased with electron and fission neutron irradiation. For a zinc-diffused sample that was initially nondegenerate at 78°K, electron irradiation caused an increase in hole density. The heavily doped samples remained p-type over the full range of temperature measurements, whereas the lower-density sample converted to n-type at higher temperatures. Models are proposed to explain these results. Theoretical calculations of lattice mobility have been made and are compared with the measured mobilities. The theoretical amount of radiation energy that goes into displacement damage in PbSnTe has been calculated for electrons of various energies and for a fission neutron spectrum. (GRA)

7231 (AD-768395) STRUCTURE AND PROPERTIES OF MELT-GROWN Nb–Nb_2C COMPOSITES. David, S. A.; Brody, H. D. (Pittsburgh Univ., Pa. (USA). Dept. of Metallurgical and Materials Engineering). 1 Sep 1973. Contract N00014-67-A-0402-0003. 41p. NTIS $3.00.

The report consists of two preprints. One preprint describes a process for growing eutectic and hypereutectic Nb–Nb_2C composites by an electron beam floating zone freezing technique. The structure is characterized as a function of carbon content and growth rate. The conditions for interface stability in the Nb–Nb_2C system are compared with present theoretical models. The second preprint discusses sources of banding in composite growth and pays particular attention to banding that results from nonuniformity in the feed rod. This mechanism is important in composite growth techniques employing zone melting and may be avoided by zone leveling prior to composite growth. (GRA)

7232 (AD-770079) CHARGE TRAPPING EFFECTS IN THIN FILMS OF Al_2O_3 AND SiO_2. Harari, E. (Princeton Univ., N. J. (USA)). Aug 1973. Contract N00014-67-C-0151-0034. 260p. (PSSL-121173). NTIS $6.25.

Electron and hole traps in metal insulator semiconductor (MIS) devices with pyrohydrolytic Al_2O_3 gate insulator have been investigated, using the MIS device as an integral detector of the charge stored in the oxide. The same detection technique has been used to investigate ionizing radiation-induced charge trapping effects in thin films of SiO_2 incorporated into MIS capacitor structures. (GRA)

7233 (BARC/I-255) HEALTH PHYSICS CONSIDERATIONS IN ENRICHED URANIUM OXIDE FUEL FABRICATION. Ramachandran, V.; Nambiar, P.P.V.J. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

The Atomic Fuels Division of the Bhabha Atomic Research Center is undertaking the fabrication of the enriched UO_2 replacement fuel blended with 1.5% Gd_2O_3 in the pellet form. The radiation hazards, both external and internal, involved in this project and the criticality aspects of the fabrication process are discussed. Area design, ventilation, house keeping operations, personal hygiene rules and waste handling procedures to keep the contamination at a minimum level are described. The importance of the periodical and frequent radiation surveys, including area monitoring, air monitoring, contamination surveys and bioassay is stressed. The factors which may lead to emergency situations are indicated and the procedures to be followed in such situations are briefly described. (INIS)

7234 (GEMP-16-B) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT No. 16, PART B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 15 Oct 1962. Contract AT(40-1)-2847. 47p. Dep. NTIS $5.50.

Declassified 21 Sep 1973.

Research progress is reported on coatings for ceramic fuel elements, coated fuel particle development and evaluation, urania–yttria fuel materials, stabilization of UO_2 in ceramic fuel elements, and fission product migration in solids. (JRD)

7235 (GEMP-58-B) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 58. PART B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 29 Apr 1966. Contract AT(40-1)-2847. 31p. Dep. NTIS $4.75.

Declassified 20 Sep 1973.

Research is reported on burnup capability of Y_2O_3-stabilized UO_2 and BeO-stabilized fuel materials. Results of studies on high-temperature properties of substoichiometric urania and urania solutions are also included along with results of research on high temperature carbides for fuel and structural uses. (JRD)

7236 (INIS-mf-978) DEVELOPMENT OF HIGH PERFORMANCE FUEL: PRELIMINARY RESULTS. Sardo, L. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Oct 1972. 25p. INIS.

From 2nd Italian-Polish meeting on some chemical, ceramic, and metallurgic aspects of nuclear fuels; Rome, Italy (3 Oct 1972).

After a phase diagram review of systems including uranium, plutonium, carbon, nitrogen, and oxygen, preliminary results of uranium and uranium–plutonium monocarbide pellets and microspheres and carbonitride pellets prepared by carbothermic reduction are described. Problems concerning initial mixture homogeneity, carboreduction reaction control, carbide powder handling, microstructure and plutonium evaporation are given. (auth) (21 figures, 5 tables)

7237 (KFKI-74-10) MAGNETIC PROPERTIES OF THE $SmFe_{1-x}Al_xO_3$ SYSTEM. Pardavi-Horvath, M. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 7p. Dep. NTIS (US Sales Only) $4.00.

Flux-grown single crystals with x = 0, 0.01, 0.04, 0.06 were investigated using a vibrating sample magnetometer in the temperature range 4.2 to 700°K. It is shown that the previously reported magnetic anomaly found by others in Sm-orthoferrite near helium-temperature is due to a compensation point, predicted by Naish and Turov, at which the magnetic moment induced in the Sm sublattice by the molecular field of Fe ions becomes equal and opposite to the weak ferromagnetic moment. The compensation temperature T_k shifts to higher temperatures on increasing the Al content. The Sm–Fe interaction energy E_{R-Fe} at T_k as determined from susceptibility and magnetization measurements decreases with increasing Al content, being E_{R-Fe} = 4.3°K for pure $SmFeO_3$ and 1.7°K for $SmFe_{0.94}Al_{0.06}O_3$. (auth)

7238 (PWAC-1018) ADVANCED MATERIALS PROGRAM FOR NOVEMBER AND DECEMBER 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 27 Jan 1965. Contract AT(30-1)-2789. 83p. Dep. NTIS $6.25.

Declassified 4 Sep 1973.

Research progress is reported on refractory alloy properties, properties of ceramic fuels, properties of alkali metals, surface chemistry, and space radiation fabrication methods. (JRD)

7239 METHOD OF VAPOR SEAL COATING PLUTONIUM OXIDE PARTICLES WITH MOLYBDENUM. Ciramella, A. F.; Jaeger, R. R.; Rogers, R. R. (to United States Atomic Energy Commission). US Patent 3,796,589. 12 Mar 1974. Filed Date 28 Jul 1972. 8p.

A method is described for applying molybdenum (Mo) coatings to actinide ceramic materials. Molybdenum pentachloride ($MoCl_5$) is reduced in the presence of the ceramic material to deposit a first part of the Mo coating and then reducing molybdenum hexafluoride (MoF_6) in the presence of the coated ceramic material to deposit a second part of the Mo coating. (Official Gazette)

7240 OPTICAL AND ELECTRICAL PROPERTIES OF BORON NITRIDE. Katzir, A. Jerusalem; Hebrew Univ. (1974). 102p. (In Hebrew).

Two forms of boron nitride (BN) were investigated including hexagonal BN (HBN), which is very soft and resembles graphite, and cubic BN (CBN), which is very hard, and resembles diamond. Several experimental methods for studying HBN are combined and used in explaining the results. The excitation of the EPR signals by uv was studied and it was found that the excitation spectra of the TBC and the OBC were very similar, and both were centered around 4.1 eV (~3000 Å). After the samples were exposed to ionizing radiation at room temperature and heated linearly, two types of glow curves were measured: thermoluminescence (TL) and thermally stimulated current (TSC). Both the glow curves showed peaks at about 375 and 700°K. It was also found that blue photoluminescence was emitted when the samples were exposed to uv. The excitation spectrum of the luminescence was centered around 3300 Å, and the emission spectrum around 4200 Å. A model is suggested to explain the results obtained. (INIS)

7241 NONDESTRUCTIVE ASSAY OF FISSILE MATERIAL SAMPLES IN SUPPORT OF NUCLEAR SAFEGUARDS. Evans, A. E. Jr. (Los Alamos Scientific Lab., NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 628-632(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Samples of fissile material can be assayed by bombarding with 300- to 600-keV neutrons and counting delayed neutrons from fission. Interrogating neutron energy selection is based upon considerations of sample penetrability and insensitivity of response to nonfissile isotopes. Significant cost savings in nuclear safeguards and quality control are possible. (auth)

7242 INVESTIGATION OF THE SPECTRA OF LIGHT REFLECTED OFF $Cd_xHg_{1-x}Te$ THIN FILMS. Ignatowicz, S. A. (Inst. of Electron Tech. of the Scientific and Production Centre of Semiconductors, Warsaw); Kisiel, A.; Zimnal, M. Thin Solid Films; 21: No. 2, 231-236(Apr 1974).

The spectra of the fundamental reflectivity of $Cd_xHg_{1-x}Te$ solid solution thin films thermally evaporated from raw polycrystalline material onto mica substrates have been investigated in the 1.7 to 5.5 eV energy range. Measurements of the positions of the reflection maxima as a function of the chemical composition determined by the spectrophotometric method for compositions from x = 0.00 up to x = 0.25 have been carried out. From these investigations a linear dependence of the positions E_1 of the reflection maxima on the composition x has been obtained. The results thus obtained are compared with results published in the literature for $Cd_xHg_{1-x}Te$ single-crystal solid solutions as well as for amorphous and polycrystalline thin films of some other materials. The possibility of obtaining a criterion for the degree of crystalline order in a thin film is considered. (auth)

7243 MOESSBAUER STUDY OF RUTHENIUM BORIDES AND PHOSPHIDES. Potzel, W. (Technische Univ., Munich); Wagner, F. E.; Wappling, R. J. Solid State Chem.; 9: No. 4, 380-383(Apr 1974).

The Mössbauer absorption of the 89-keV gamma rays of ^{99}Ru has been used in a study of a series of ruthenium borides and phosphides. The results are compared with Mössbauer data for the corresponding iron compound. The Mössbauer parameters of the transition metal atom in the borides turn out to be rather insensitive to the detailed boron surrounding. The results for the phosphides suggest similar electron configurations for the iron and corresponding ruthenium compounds. (auth)

7244 SINGLE-CRYSTAL STUDY OF EIGHT-LAYER BARIUM NIOBIUM LITHIUM OXIDE, $Ba_4Nb_3LiO_{12}$. Jendrek, E. F. Jr.; Potoff, A. D.; Katz, L. (Univ. of Connecticut, Storrs). J. Solid State Chem.; 9: No. 4, 375-379(Apr 1974).

A single-crystal study of a sample of $Ba_4Nb_3LiO_{12}$ has been carried out and confirms the |(4)|(4)| layer stacking scheme (Zhdanov notation) for the eight BaO_3 layers per unit cell. Of the eight MO_6 octahedra per cell (M = Nb or Li), four share faces in pairs, and these pairs are linked by pairs of corner-sharing MO_6 octahedra. The compound has a hexagonal cell of dimensions a = 5.777 ± 0.006 Å and c = 18.95 ± 0.03 Å, probable space group $P6_3/mmc$, Z = 2. The theoretical density is 6.22 g/cm³; within the limit of error of the pycnometrically measured density, 6.08 ± 0.06 g/cm³. The study was carried out with 620 independent reflections, of which 437 were considered observed, collected by automated counter methods and refined by least-squares to a conventional R value of 0.076. (auth)

7245 SUPERCONDUCTIVITY IN ALKALINE EARTH METAL AND Yb INTERCALATED GROUP VI LAYERED DICHALCOGENIDES. Subba Rao, G. V.; Shafer, M.W.; Kawarazaki, S.; Toxen, A. M. (Watson Research Center, Yorktown Heights, NY). J. Solid State Chem.; 9: No. 4, 323-329(Apr 1974).

Alkaline earth metals and Yb have been intercalated into Group VI layered dichalcogenides, e.g., MoS_2, by the liquid ammonia method at low temperatures. Results of chemical analysis and x-ray data indicate that ammonia is also intercalated along with the metal and that the c axis increases by ~3 Å in all the intercalated materials. In most cases, these compounds are only partially intercalated in that some pure unintercalated phase is present. Superconductivity has been observed in these intercalated compounds with the highest value T_{onset} of 5.7°K for $Ba_x(NH_3)_yMoS_2$; the T_{onset} temperatures depend on the nature of the metal and the host dichalcogenides but not on the concentration of the intercalated metal ion. Fine-particle (1-10 μm size) materials which are fully intercalated do not exhibit the superconductivity behavior as measured by the ac susceptibility method. The results are discussed in terms of the current band models for the Group VI MCh_2 materials and compared with alkali metal intercalated MoS_2. (auth)

7246 INVESTIGATIONS WITHIN THE TERNARY SYSTEMS: Cr–B–C, Mn–B–C, AND Mn–Ge–C. Papesch, G. (Univ., Vienna); Nowotny, H.; Benesovsky, F. Monatsh. Chem.; 104: No. 5, 933-942(Jul 1973). (In German).

A new monoboride phase CrB displaying a δ-MoB–CrB-type transposition (shift) structure has been detected in alloys which were prepared at relatively low temperatures. Furthermore, a Cr-rich boride phase not yet characterized was observed. The mutual solubility of the respective Cr-carbides and borides is insignificant for 1000°C. Under the same conditions a phase close to MnB has been found besides the known MnB (FeB-type). The new phase crystallizes with a structure similar to the CrB-type, however some additional clarification is needed. Carbon–boron substitution in $Mn_{23}C_6$ extends to almost $Mn_{23}B_3C_3$. Germanium and carbon stabilize γ-Mn solid solutions towards lower temperatures. Besides the ordering phenomenon there is an almost continuous transition between γ-Mn(Ge,C) solid solutions and the perovskite carbide Mn_3GeC_x. Indications for the existence of derivatives of the perovskite carbides were observed. (INIS)

7247 CHARACTERISATION OF SINGLE CRYSTALS OF CADMIUM TELLURIDE FOR ION IMPLANTATION STUDIES. Gettings, M.; Stephens, K. G. (Univ. of Surrey, Guildford, Eng.). J. Cryst. Growth; 22: No. 1, 50-52(Mar 1974).

Single crystals of cadmium telluride grown by three different methods have been heated in isochronal steps to 600°C in an argon gas flow and in an evacuated ampoule. The effects of these heat treatments were studied by Rutherford backscattering of 1.5 MeV helium ions and by a simple thermal probe. Changes in the lattice order of material grown by a modified Bridgman method were noted but no such changes in horizontally and vertically zone refined samples were detected. The surfaces of all samples were p-type when in equilibrium with air and were affected by heating, conductivity changes being more noticeable with the argon gas flow method. (auth)

7248 HELICAL GROWTH DEFECTS IN GADOLINIUM GALLIUM GARNET. Stacy, W. T.; Pistorius, J. A.; Janssen, M. M. (Philips Research Labs., Eindhoven, Netherlands). J. Cryst. Growth; 22: No. 1, 37-43(Mar 1974).

An x-ray topographic study of helical line defects in Czochralski grown $Gd_3Ga_5O_{12}$ is described. Both the Lang transmission configuration and the double reflection method have been employed to characterize the strain field in and around the helices. From this study it is concluded that the helix is a dislocation of the prismatic, interstitial type which surrounds a helicoidal region of smaller lattice constant. The topographs also reveal an alignment of the helix loops with the crystal growth striae. (auth)

7249 X-RAY TOPOGRAPHIC AND ELECTRON MICROSCOPIC STUDIES OF LATTICE DEFECTS IN VAPOR-GROWN $ZnIn_2S_4$ AND $Zn_3In_2S_6$ CRYSTALS. Buck, P. (Univ., Freiburg, I. B.). J. Cryst. Growth; 22: No. 1, 13-21(Mar 1974).

Single crystals of the compounds $ZnIn_2S_4$ and $Zn_3In_2S_6$ were grown from the vapor phase by chemical transport. Their defect structures were studied by x-ray topography (Lang method) and electron microscopy. The x-ray topographic investigations revealed dislocations, stacking faults, and growth bands. All dislocations are of the type b = [100] and run parallel to the cleavage plane (0001). It appears possible to grow nearly dislocation-free crystals. Stacking faults (parallel to (0001) with ⅓ [210]-type fault vector) were occasionally observed in $ZnIn_2S_4$ only. The growth bands are probably due to fluctuations in impurity concentration. The electron microscopic studies frequently revealed hexagonal nets of screw dislocations. Dislocation dissociation into partials or dislocations perpendicular to (0001) were not observed. Spherical or disc-shaped voids can be formed in the crystals by prolonged electron bombardment. (auth)

7250 ELECTROCHEMISTRY OF CERAMIC ELECTROLYTES. Worrell, W. L. (Univ. of Pennsylvania, Philadelphia). Amer. Ceram. Soc. Bull.; 53: No. 5, 425-433(May 1974).

Defect structures and conduction mechanisms in the more useful ceramic electrolytes are described. High-temperature thermodynamic investigations, kinetic studies and technical applications using solid oxide electrolytes are reviewed. The review is selective and emphasizes electrochemical principles and current research problems. Recent research with new ceramic electrolytes which can function as electrochemical probes for sulfur and carbon is described. Materials discussed include $ThO_2-Y_2O_3$, and ZrO_2-CaO. (10 figures, 114 references) (auth)

7251 THERMAL EXPANSION OF THE ACTINIDE DIOXIDES. Fahey, J. A. (Bronx Community Coll., NY); Turcotte, R. P.; Chikalla, T. D. Inorg. Nucl. Chem. Lett.; 10: No. 6, 459-465 (Jun 1974).

Results are presented of studies of thermal expansion of NpO_2, AmO_2, and BkO_2 under one atmosphere oxygen pressure at decreasing temperature between approximately 1000°C and ambient. A comparative analysis of the entire actinide series is also made,

which shows a regular trend to increasing high temperature expansion with increasing atomic number. Curves are shown of (a) thermal expansion plotted as lattice constant versus temperature; and (b) room temperature lattice parameters and expansion coefficients at 25 and 900°C plotted versus atomic number. (UK)

7252 COMPARATIVE ELECTRON PARAMAGNETIC RESONANCE STUDY OF Fe^{3+} AND Gd^{3+} IONS IN MONOCLINIC ZIRCONIA. Bacquet, G.; Dugas, J.; Escribe, C.; Gaite, J. M.; Michoulier, J. (Univ., Toulouse). J. Phys., C (London); 7: No. 8, 1551-1563(21 Apr 1974).

The paramagnetic spectra of Gd^{3+} and Fe^{3+} in monoclinic zirconia single crystals were investigated in the Q-band. In both cases, a unique type of defect was observed, thus confirming that the trivalent ion has no O^{2-} vacancy in nearest-neighbor positions. The spectra were fitted to the most general spin hamiltonian, the constants of which were obtained for both ions. Analyzing the pseudosymmetry of the fourth-order terms of the crystal field, it was found that Fe^{3+} did not modify its immediate environment and that the Gd^{3+} local symmetry developed is very close to that of the tetragonal ZrO_2 lattice. (auth)

7253 X-RAY AND DENSITY STUDIES OF NONSTOICHIOMETRIC URANIUM SESQUINITRIDE. Tagawa, H.; Masaki, N. (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 36: No. 5, 1099-1103(May 1974).

The lattice parameters of nonstoichiometric $\alpha-U_2N_3$ were determined in the composition range of $UN_{1.49}$ to $UN_{1.75}$. The single-phase region was from $UN_{1.54}$ to $UN_{1.75}$. Beyond the N/U atom ratio of 1.75, the structure was transformed from an Mn_2O_3-type bcc to a CaF_2-type pseudo fcc. Using the estimated lattice parameter for UN_2, two separate linear relationships for the lattice parameter as a function of nitrogen content were obtained; one is characteristic of U_2N_3 and the other of UN_2. The densities were also determined; the values obtained were consistent with a nitrogen interstitial model for U_2N_{3+x}. (auth)

7254 p-T PHASE DIAGRAM OF THE NIOBIUM-NITROGEN SYSTEM. Levinskii, Yu. V. Izv. Akad. Nauk SSSR, Metal.; No. 1, 52-55(1974). (In Russian).

On the basis of an analysis of the available experimental data on equilibria in the Nb-N system, a p-T phase diagram is proposed for this system. Isobaric (at pressures of 1 to 10^{-3} atm nitrogen) and isothermal (at temperatures of 1300 to 2400°C) cross sections of the Nb-N phase diagram are presented. Various equilibria and transitions of the α, β, γ, δ, and ϵ phases are presented. (SJR)

7255 INTERNAL NITRIDE FORMATION IN Fe-Ti, Fe-V, AND Fe-Nb ALLOYS. Witt, M. Stuttgart; Univ. Stuttgart (1974). 47p. (In German).

Thesis.

The type of action between the alloying element and the penetrated nitrogen and the effect of nitrogen diffusion were examined in the temperature range from 300 to 600°C. For preparative reasons, the precipitated nitride precipitates were not observed. When nitrating in a hydrogen-ammonia mixture, the increase in weight was continually or point for point measured. The penetration of the nitrate layer was tested with etched cross microsections and microhardness profiles. The nitration kinetics is only diffusion determined below 450°C. By comparing the effective stoichiometric relationship $\nu_{exp} = 1.9$, which results from the increase in weight and the layer thickness, with a corresponding value $\nu_{bin} = 1.2$, which results from the kinetics, it was indirectly concluded that a nitride somewhat of the composition of TiN is precipitated and a more or less equal share of nitrogen (varying according to nitration temperature) is weakly bound to dissolved alloying atoms by adsorption. With suitable hardness profiles, the theory of inner oxidation is used for the kinetics. For a general evaluation, the existence of a finite solubility product was assumed. According to these evaluations, the nitrogen diffusion seems to be delayed. (GE)

7256 ELECTRON-BEAM INDUCED REDUCTION OF CARBON CONCENTRATION ON BeO AND ITS EFFECTS ON SECONDARY ELECTRON EMISSION. Goldstein, B. (RCA Labs., Princeton, NJ). Surface Sci.; 39: No. 2, 261-271(Sep 1973).

Electron-beam stimulated reduction of C concentration on BeO, which requires an oxygen ambient $\sim 10^{-7}$ torr, was studied using Auger spectroscopy. As the C Auger line decreases, those of Be and O increase, the secondary electron emission ratio delta increases, and the work function decreases. It is concluded that these effects stem from electron stimulated desorption of C. The desorption process is monomolecular, at least initially, with a cross section of about 2.1×10^{-20} cm^2, from which it is inferred that the desorbing species is CO^+. The adsorbed C, initially in the graphite form, can be converted to the carbide form by heat treatment as low as 450°C. This conversion is accompanied by a decrease in work function of 2.50 V from the value associated with the graphite C. The magnitude of the Auger electron signal from carbide C decreases under electron beam irradiation; however, in this case, the reduction in the magnitude of the C Auger line is not accompanied by any change in delta or yield curve. It is suggested that this decrease is not due to desorption of the carbide C, but rather to an electron-induced change in the C bonding state. (auth)

7257 COMMENTS ON LEITNAKER AND SPEAR'S PAPER "ELIMINATION OF CO_2 AND H_2O AS OXYGEN TRANSPORT SPECIES IN MIXED OXIDE FUEL PINS". Adamson, M. G. (General Electric Co., Pleasanton, CA); Aitken, E. A.; Rand, M. H. J. Nucl. Mater.; 50: No. 2, 217-222(Mar 1974).

Results are presented to show that C and H fabrication impurities found in mixed oxide fuel pins are not removed by burnup and that they are present at the end of life in these fuels. Results show that for mixed oxide fuels with initial $O/M \geq 1.98$ radial oxygen redistribution is probably complete within 48 h, occurring predominantly via the H_2/H_2O and/or CO/CO_2 gas phase transfer paths. Later in life the relative importance of these gaseous transfer paths diminish due to the combined effect of factors such as reduction in overall O/M due to reaction with the clad, reduction in in $P_{H_2+H_2O}$ and/or P_{CO+CO_2}, and densification of the fuel, however they always remain operative. The result of a diminishing contribution from the Z-ZO paths (Z = H_2 or CO) is a small change in the original oxygen gradient. In initially low O/M fuels (<1.98) the importance of the Z-ZO paths in determining total oxygen redistribution is smaller than when $O/M \geq 1.98$; towards end-of-life their contribution becomes extremely small, however, it is unlikely that they ever are entirely eliminated. The most important oxygen carriers in low O/M fuels are probably the gaseous actinide oxides (UO_2, PuO, UO_3, and UO) and oxygen ions. At high burnups volatile fission product compounds such as CsOH and Cs_2MoO_4 may become important. (JRD)

7258 CHEMICAL VAPOR DEPOSITION OF ZrC ON PYROCARBON-COATED FUEL PARTICLES. Reynolds, G. H. (General Atomic Power Systems, San Diego, CA). J. Nucl. Mater.; 50: No. 2, 215-216(Mar 1974).

Laboratory scale production of composite fuel particles is described in which pyrocarbon-coated UO_2 particles are further coated with a layer of ZrC by chemical vapor deposition. A schematic of the deposition apparatus is included along with a micrograph of a composite particle. (JRD)

7259 MICROANALYSIS OF REACTOR FUEL PARTICLES IRRADIATED AT HIGH TEMPERATURES. Morlevat, J. P. (CEA-DMECN, Grenoble, France). J. Nucl. Mater.; 50: No. 2, 119-126(Mar 1974). (In French).

The nature and distribution of fission products in the cladding layers surrounding fuel particles for an HTR reactor have been studied. For irradiation temperatures around 1300°C, the fission products are arrested by the inner PyC layers or (in the case of cesium) by the silicon carbide layer. For higher irradiation temperatures, a partial destruction of the cladding layers is observed, and fission products of generally low mobility are present outside the fuel nucleus. Microanalysis of the particles has permitted the radial distribution of plutonium to be measured within the fuel nucleus, revealing a rapid variation near the surface of the nucleus. (auth)

7260 ANALYTICAL EXPRESSIONS FOR ENTHALPY AND HEAT CAPACITY FOR URANIUM-PLUTONIUM OXIDE. Gibby, R. L. (Hanford Engineering Development Lab., Richland, WA); Leibowitz, L.; Kerrisk, J. F.; Clifton, D. G. J. Nucl. Mater., 50: No. 2, 155-161(Mar 1974).

Enthalpy data which have been reported for UO_2-(20 to 25) wt % PuO_2 in the range from room temperature to ≈3000°K were fitted through non-linear regression analysis to an Einstein function modified with a defect formation energy term. An expression for heat capacity was derived by differentiating the enthalpy function with respect to temperature. The fitted parameters in the modified Einstein functions are compared with theoretical values calculated for the UO_2-PuO_2 lattice. Polynomial temperature functions were determined using the smoothed values for enthalpy and heat capacity given by the Einstein functions, thus providing simpler alternate expressions for these two properties. (auth)

7261 FORMATION OF SOLID SOLUTIONS $Nb_xTa_yO_2$ ($0.8 \leq x + y \leq 1.0$) BY THE ACTION OF SHOCK WAVES ON THE SUBSTANCE. Anan'in, A. V.; Breusov, O. N.; Dremin, A. N.; Drobyshev, V. N.; Pershin, S. V. Zh. Neorg. Khim.; 19: No. 3, 710-713(Mar 1974). (In Russian).

It was shown that shock waves act on a mixture of Nb and Ta pentaoxides to form solid solutions of the type $Nb_xTa_yO_2$ ($0.8 \leq x + y \leq 1.0$) with an "ideal" structure of the rutile type. The

area of monophase solid solutions extends at least from the pure Nb_xO_2 phase to $Nb_{0.6}Ta_{0.4}O_2$. A probable mechanism of Me_xO_2 phase formation in experiments on shock compression is discussed. (tr-auth)

7262 MECHANISM OF THE RESTORATION OF THE CENTER OF THE SMOKY COLOR OF THERMOCHEMICALLY TREATED α-QUARTZ BY RADIATION. Vakhidov, Sh. A.; Gasanov, E. M.; Ibragimov, Zh. D.; Yarkulov, U. Sov. Radiochem. (Engl. Transl.); 15: No. 3, 469-471(1973).

Translated from Radiokhimiya; 15: No. 3, 462-464(1973).

The four mechanisms examined are: conversion of interstitial aluminum ions into the structural form; removal of a hydrogen ion (proton) from "aluminum" defects by ionization; direct ejection of a proton by neutrons or displaced oxygen and silicon atoms; and removal of a proton by thermal diffusion. Irradiation of thermochemically treated quartz with gamma rays up to a 10^3 R dose did not restore the smoky color. In the irradiation of a thermochemically treated crystal with neutrons the hydrogen bond in the aluminum–hydrogen center is ruptured as a result of a thermal peak and then the protons are captured by displaced oxygen ions and in this way the color centers of the crystal are restored. (LK)

7263 ORDER–DISORDER TRANSFORMATIONS OF INTERSTITIAL SOLUTES IN TRANSITION METALS OF IV AND V GROUPS. Hirabayashi, M.; Yamaguchi, S.; Asano, H.; Hiraga, K. (Tohoku Univ., Sendai). (1973). vp.

From international symposium on order–disorder transformation in alloys; Tuebingen, Ger. (3 Sep 1973).

A survey is presented of the order–disorder transformations in the interstitial alloys of transition metals with hydrogen, deuterium, and oxygen. Special attention is given to the formation of interstitial superstructures, stepwise processes of disordering and property changes attributed to order-disorder. Four groups of interstitial alloys are considered: (1) Ti–O, Zr–O, Hf–O, (2) V–O, (3) V–H, V–D, and (4) Ta–H, Ta–D. Characteristic features of the phase transformations in each group and each system are presented and discussed in comparison with others. (INIS)

7264 FERROMAGNETIC PHASE IN THE PRODUCTS RESULTING FROM BOILING $Cd(OH)_2/Fe(OH)_3$. Wolski, W. (Adam-Michiewicz-Univ., Poznan, Poland). Monatsh. Chem.; 104: No. 5, 1276-1282(Sep 1973). (In German).

In the system $CdO \cdot xFe_2O_3$ formed from co-precipitated and boiled hydroxides of cadmium(II) and iron(III) the following can be identified by x-ray study: at $x \leq 0.8$–besides the $Cd(OH)_2$ phase γ-Fe_2O_3 at $1.5 \geq x \geq 0.8$ fine crystalline γ-Fe_2O_3 and traces of α-Fe_2O_3, at $4 > x > 1.5$ both modifications, i.e., γ-Fe_2O_3 and α-Fe_2O_3, and at $x > 4$ only α-Fe_2O_3. The course of specific magnetization as a function of composition confirms the x-ray findings. (INIS)

7265 DOUBLE TUNGSTATES OF RUBIDIUM AND RARE EARTHS. Trunov, V. K.; Rybakov, V. K. (Moscow State Univ.). Zh. Neorg. Khim.; 19: No. 3, 636-640(Mar 1974). (In Russian).

X-ray phase analysis and differential thermal methods were used to study the polymorphism of double Rb–RE tungstates. Using monocrystal data, the parameters of the elementary cell were determined for most of the modifications of these compounds. (tr-auth)

7266 GRADED IMPACT RESISTANT STRUCTURE OF TITANIUM DIBORIDE IN TITANIUM. Clougherty, E. V. (to Man-Labs., Inc.). US Patent 3,802,850. 9 Apr 1974. Filed date 13 Nov 1972. 10p.

A new product resistant to impact from foreign bodies including both erosion and collision is described which has a graded structure with an outwardly facing surface prepared from a mixture of titanium and titanium diboride. For a specific purpose of ballistic impact resistance, the product has a graded structure wherein the exposed or impact receiving face has a composition corresponding to a mixture of titanium and boron in a range between the approximate equivalents of 25 to 60% titanium diboride and the remainder primarily titanium, while the inwardly facing surface is primarily titanium or a titanium alloy. The presently preferred process for producing the product comprises mixing powders of titanium and geometry titanium diboride in the desired graded geometry and hot pressing them, desirably with a sheet or structure of titanium or titanium alloy or a similar support material at the back surface. (Official Gazette)

7267 ELECTRICAL CONDUCTIVITY OF THORIA. George, A. M.; Karkhanavala, M. D. (Bhabha Atomic Research Centre, Bombay). Indian J. Pure Appl. Phys.; 11: No. 12, 904-907(Dec 1973).

The electrical conductivity of thoria was studied in air from 25 to 500°C and in a reactor up to a total integrated neutron flux of about 10^{18} n/cm^2. The conductivity and the activation energy for conduction are found to depend upon the density of the sample, possibly as a result of absorption of hydroxyl groups and water molecules on the oxide surface. The reactor radiations cause a sudden increase in the conductivity, reaching to saturation within about 30 min. On withdrawal from the radiation field, the conductivity quickly drops and gradually approaches the pre-irradiation value. Repeated cycling does not seem to have any noticeable effect. It has been shown that the variations in the conductivity are mainly due to the ionizations and the electron excitations and that at these neutron doses negligible defects are produced in the lattice. (auth)

7268 ZIRCONIUM OXIDE SOLS (PREPARATION AND PURIFICATION). Bhatt, I. M. (Gujarat Univ., Ahmedabad, India). Vidya; 14: No. 2, 7-11(1971).

A survey of the methods of preparation of zirconium oxide sol is done. Zirconium oxide sol prepared by hydrolysis of zirconium nitrate was subjected to dialysis for purification. The analysis of the sol and the dialysate with time are also given. (Indian Sci. Abstr.)

7269 RE-SOLUTION-CONTROLLED FISSION-GAS BEHAVIOR IN UO_2 IRRADIATED IN A FAST FLUX. Pati, S. R.; Dapht, M. J.; O'Boyle, D. R. (Argonne National Lab., Ill.). J. Nucl. Mater.; 50: No. 3, 227-246(Apr 1974).

Uranium dioxide irradiated in a fast neutron flux to a burnup of 2×10^{20} fissions/cm^3 between 650 and 1400°C has been examined by transmission- and scanning-electron microscopy and replication metallography. The fission-gas distribution in the fuel matrix and grain boundaries has been characterized as a function of irradiation temperature and fission rate. The majority of fission gas produced even at the highest irradiation temperature was in the UO_2 matrix either in solution or in the form of bubbles <20 Å in diameter. The results are explained on the basis of an irradiation-induced re-solution mechanism whereby fission gas from within bubbles is reinjected into metastable solution in the UO_2 lattice. Calculated fission-gas solubilities are given as a function of temperature for 10^{13}, 3×10^{13}, and 10^{14} fissions/cm^3/s, and, based on these results, it is concluded that the re-solution process is operative over a substantial fuel volume of both light-water-reactor and fast-breeder-reactor oxide fuels. (auth)

7270 THERMAL ION EMISSION FROM SOME TRANSITION METAL CARBIDES HEATED ON GRAPHITE FILAMENT. Sasaki, N.; Kubo, K.; Asano, M. (Institute of Atomic Energy, Kyoto University, Uji, Kyoto, Japan). J. Chem. Phys. 60: No. 4, 1575-1577 (15 Feb 1974).

Thermal ion emissions from the carbides of Ti, Zr, Hf, V, Nb, and Mo heated on graphite filament have been studied by means of the mass spectrometric single filament surface ionization technique. With Ti–C, Zr–C, Hf–C, V–C, and Nb–C systems dicarbide ions and with Mo–C system monocarbide ions were identified, respectively, in addition to the corresponding metal ions. Abundance ratios $MC_2^+(g)/M^+(g)$ and heats of vaporization of some ionic species were determined, and heats of vaporization of neutral species were also derived. (auth)

7271 MAGNETIC FIELD DEPENDENCE OF THE JAHN-TELLER TRANSITION IN $DyVO_4$. Pytte, E. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Phys. Rev. B 9: No. 3, 932-941 (1 Feb 1974).

The effect of a magnetic field on the magnetically controllable cooperative Jahn-Teller distortion in $DyVO_4$ has been investigated. Results are presented of calculations of the temperature and field dependence of the strain distortion e_{11}–e_{22} and the elastic constant c_{11}–c_{12}, the temperature (strain) dependence of the g factors and the paramagnetic susceptibility tensor, and the temperature and field dependence of the four-low-lying crystal-field levels. For fields in the xy plane, a phase transition occurs only for $H_x = H_y$. For all other orientations in the plane, the field induces a distortion which persists to all temperatures. For fields along the z axis a first-order transition to a new magnetic phase is predicted, the stability limit of which has been calculated as function of temperature and field. The excitation frequency determined by the separation of the middle-two crystal-field levels goes to zero at the stability limit and is the soft-mode frequency associated with the transition (auth)

7272 X-RAY $M_{II,III}$ EMISSION BANDS OF PERIOD I TRANSITION METALS IN DIBORIDES. Shulakov, A.S.; Lyakhovskaya, I.I.; Fomichev, V.A. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Solid State 15: No. 7, 1503-1504 (Jan 1974).

The $M_{II,III}(3p)$ x-ray emission bands of metals in the compounds ScB_2, TiB_2, VB_2, CrB_2, and MnB_2 were obtained with an RSL–1500 x-ray spectrometer. The observed shifts in these bands are correlated to the electronic structures of these compounds. (AIP)

7273 EFFECT OF PRESSURE ON THE PROPERTIES OF REACTIVELY SPUTTERED Ta_2O_5. Westwood, W.D.; Boynton, R.J.; Ingrey, S.J. (Bell-Northern Research, Ottawa, Canada). J. Vac. Sci. Technol. 11: No. 1, 381-384 (Jan 1974).

Films of Ta_2O_5 have been prepared by reactive sputtering of tantalum in argon–oxygen dc glow discharges. Such films are of interest for capacitor dielectrics and optical waveguides, and for both applications the films must be free of pores. The effects of sputtering pressure on the density, refractive index, and dielectric constant of the films has been investigated. In the case of metal films, significant decreases in density are caused by increasing the sputtering pressure, a similar effect has been observed in the Ta_2O_5 case. The density decreases from 7.8 to 5.9 g/cm³ as the pressure is increased from 25 to 60 mTorr, and there are associated changes in related properties. The sputtering pressure can be controlled by adjusting the argon–oxygen mixture, but this also changed the deposition rate. Optical emission or mass spectrometry is used to ensure that the oxygen concentration is high enough for the deposition of Ta_2O_5 films rather than oxygen-doped tantalum; no emission from oxygen is observed until this concentration is reached. (auth)

7274 GROWTH AND STUDY OF CRYSTALS OF DOUBLE OXIDES OF CADMIUM WITH STRUCTURES OF THE PEROVSKITE TYPE. I. CADMIUM HAFNATE. Spinko, R.I.; Lebedev, V.N.; Kolesova, R.V.; Fesenko, E.G. (Rostov State University). Sov. Phys.–Crystallogr. 18: No. 4, 536-537 (Jan 1974).

Single crystals of $CdHfO_3$ were grown from the melt and their ferroelectric and antiferroelectric transitions were investigated by dielectric constant (1 kHz) and x-ray diffraction measurements.(AIP)

7275 THERMAL CONDUCTIVITIES OF PYROLYTIC HAFNIUM NITRIDE AND CARBIDE. Fridlender, B.A.; Neshpor, V.S.; Sokolov, V.V. (State Applied Chemistry Institute). High Temp. 11: No. 2, 376-379 (Nov 1973).

The thermal diffusivity of $HfN_{1.02}$ and of $HfC_{0.94}N_{0.01}$ was measured by a phase method using electronic measurement of the phase difference between a periodic heat flux and the temperature waves on the opposite surfaces of a plate.

7276 THERMOPHYSICAL PROPERTIES OF ZIRCONIUM CARBIDE IN THE HIGH-TEMPERATURE REGION. Mebed, M.M.; Yurchak, R.P.; Korolev, L.A. (M. V. Lomonosov Moscow State University). High Temp. 11: No. 2, 380-381 (Nov 1973).

The temperature conductivity, specific heat, and thermal conductivity of zirconium carbide are measured. (AIP)

7277 THERMAL CONDUCTIVITY OF A COMPLEX CARBIDE SYSTEM TaC–WC. Grebenkina, V.G.; Sorokin, V.N. (Institute of Material Science Problems, Academy of Sciences of the Ukrainian SSR). High Temp. 11: No. 2, 263-265 (Nov 1973).

The authors investigated the temperature dependence of complex TaC–WC carbides in the range extending from room temperature to 900°C. They showed that these coefficients decrease in the solid solution range up to the single-phase region because of the changing density of electronic conditions at the Fermi surface whereas in the two-phase region its change is additive. (auth)

7278 SPIN–LATTICE RELAXATION OF Mo^{3+} IONS IN YTTRIUM ALUMINUM GARNET SINGLE CRYSTALS. Markosyan, E.A.; Petrosyan, A.G.; Sharoyan, E.G. (Institute of Physical Research, Academy of Sciences of the Armenian SSR, Ashtarak). Sov. Phys.–Solid State 15: No. 8, 1662-1662 (Feb 1974).

The spin–lattice relaxation times of Mo^{+3} ions in $Y_3Al_5O_{12}$ (YAG) have been determined from the thermal broadening of the esr absorption curves as measured by a radio-frequency spectrometer at D=9.56 Hz. (AIP)

7279 MICROSCOPIC MAGNETIC PROPERTIES OF METALLIC AND INSULATING V_4O_7 AND V_7O_{13}. Gossard, A.C.; Remeika, J.P.; Rice, T.M.; Yasuoka, H. (Bell Laboratories, Murray Hill, New Jersey 07974); Kosuge, K.; Kachi, S. Phys. Rev. B 9: No. 4, 1230-1239 (15 Feb 1974).

The local magnetic properties of the various atomic sites in metallic and insulating V_4O_7 and V_7O_{13} have been determined by means of ^{51}V nuclear magnetic resonance. Remarkably free-spin–like paramagnetic behavior is found in metallic V_4O_7 and V_7O_{13}, although there is not full differentiation into 3+ and 4+ charge states on the different sites. Below the V_4O_7 metal–insulator transition, one group of V^{4+} ions forms nonmagnetic singlet spin pairs in the insulating phase while, the remainder of the sites are paramagnetic. In the antiferromagnetic insulating state two magnetic vanadium sites with hyperfine fields 70.1 and 78.4 kOe and one nonmagnetic vanadium site are found. These results are analyzed in terms of various theoretical models, i.e., a modified Hubbard model and small-polaron model. None of the theoretical models is satisfactory. (auth)

7280 CURRENT UNDERSTANDING OF CHARGES IN THE THERMALLY OXIDIZED SILICON STRUCTURE. Deal, B. E. (Fairchild Camera and Instrument Corp., Palo Alto, CA). J. Electrochem. Soc.; 121: No. 6, 198C-205C(Jun 1974).

Generally accepted facts along with unanswered questions, concerning the four charges, Q_m, Q_0, N_{it}, and N_{ot}, associated with the thermally oxidized silicon system are presented and briefly discussed. The discussions and information presented are based on comprehensive investigations carried out in the semiconductor industry over the past ten years. Although reasonably good empirical information concerning charge dependence on device processing is available, much remains to be learned regarding the physical origin of these charges. A simplified model is presented which indicates that most of the charges can be related to silicon bond defects in the thermally oxidized silicon structure. (auth)

Metals and Alloys

Refer also to abstracts 6009, 6010, 6011, 7238, and 8694.

7281 (AECL-4363) HIGH VOLTAGE ELECTRON MICROSCOPY. Possible Applications at Chalk River Nuclear Laboratories. Hastings, I. J.; Howe, L. M.; Ploc, R. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Mar 1974. 68p. Dep. NTIS (US Sales Only) $6.50. AECL $1.50.

Aspects of high voltage electron microscopy are discussed, with emphasis on possible applications at Chalk River Nuclear Laboratories (CRNL). Selected applications include creep and strain studies, interaction of dislocations with radiation produced defects, interaction of dislocations with second phase particles, examination of reactor fuels and thermally grown zirconium oxide films, dynamic studies of dislocations, and ion implantation damage investigations. Electron accelerating potentials of 1000 to 1430 keV in a high voltage electron microscope (HVEM) are well in excess of those available in conventional (1.00 to 200 keV) instruments (CEM) and confer accompanying benefits. Due to improved penetration, samples displaying properties closer to those of the bulk state can be examined. In addition, the HVEM exhibits the important characteristics of reduced spherical and chromatic aberrations and increased accuracy of selected area diffraction. As a consequence of the atomic displacements produced by a high voltage electron beam, in-situ radiation damage experiments can be carried out on a routine basis. Additionally, because of the reduction in ionization cross sections at high voltages, it is possible to examine electron-sensitive materials in a HVEM. (116 references) (auth)

7282 (N-73-27809) FIELD REPAIR OF COATED COLUMBIUM THERMAL PROTECTION SYSTEM (TPS). Final Report, June 1970–October 1972. Culp, J. D. (McDonnell-Douglas Astronautics Co., St. Louis, Mo. (USA)). 15 Sep 1972. Contract NAS8-26121. 204p. (NASA-CR-124295; MDC-E-681). NTIS $12.25.

The requirements for field repair of coated Nb panels were studied, and the probable causes of damage were identified. The following types of repair methods were developed, and are ready for use on an operational system: replacement of fused slurrey silicide coating by a short processing cycle using a focused radiant spot heater; repair of the coating by a glassy matrix ceramic composition which is painted or sprayed over the defective area; and repair of the protective coating by plasma spraying molybdenum disilicide over the damaged area employing portable equipment. (auth)

7283 (PWAC-1019) ADVANCED MATERIALS PROGRAM FOR JANUARY AND FEBRUARY 1965. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 7 Apr 1965. Contract AT(30-1)-2789. 88p. Dep. NTIS $6.50.

Declassified 4 Sep 1973.

A tentative diagram of the 1538°C isotherm representing the niobium-rich corner of the Nb–Zr–C system was completed and a three-dimensional model of the most probable phase diagram was constructed. The room temperature ductility of the Ti–Al–Zr–C alloy was greatly improved after a high temperature annealing treatment. Problems associated with non-consumable melting were eliminated by consumable electrode melting of larger size ingots. A uranium nitride specimen containing 2500 ppM oxygen as agglomerated UO_2 was observed to redevelop a finely dispersed second phase after resintering. The pressure of N_2 over $ThN_{1.05}$ was expressed by: $\log P_{N_2}$ (atm) = $2.89 - 1.81 \times 10^4\ T^{-1}$ (T°K) based on preliminary Knudsen effusion experiments. The apparent self-diffusion coefficient for nitrogen in polycrystalline UN from 1250 to 1550°C where grain boundary diffusion predominates was described by the relationship: $D = 1.3 \times 10^{-6}\ e^{-19,700/RT}\ cm^2/sec$. From 1520 to 1800°C the measured bulk diffusion was represented by the equation: $D = 2.8 \times 10^{-5}\ e^{-46,800/RT}\ cm^2/sec$. Electrical resistivity of hot-pressed UN was determined over the temperature

range of 23 to 1300°C. At 1000°C the electronic contribution to the thermal conductivity was 0.65 for UN as compared to 0.95 for UC. Compression creep tests performed on uranium nitride in the temperature range 1100 to 1250°C gave an activation energy of about 63 kcal/mole. The stress dependency of the creep rate of UC was proportioned to $\sigma^{2.3}$ at 1300°C. This stress dependency appears to be valid at temperatures down to 1100°C. Uranium carbide was inoculated with helium to produce gas bubbles simulating fission gas bubble formation. Preliminary studies of inoculated specimens showed that the bubbles migrated to higher temperature regions when subjected to a thermal gradient. Analysis of fuel swelling data indicated that surface tension was the major restraining force in UN while creep restraint predominates in UC under SNAP-50 fuel irradiation conditions. The major effort this period was concentrated on developing sintering techniques for tungsten, molybdenum and niobium cermets containing UN, UC, and UO_2. Wet mixing of tungsten and UN was investigated as a method of improving the dispersion of the UN. Results of nitric acid leach studies of UN–W cermets indicated that the finer the particle size, the less the weight loss. This was confirmed in two vacuum weight loss tests at 2480°C. A compatibility program has been initiated to study the interaction of various ceramic fuels with potential refractory metal matrix materials. Additional compatibility data for PWC-11 alloy specimens after 3000 hours in a 1080°C boiling potassium loop indicated zirconium concentrations were not significantly affected by the potassium environment or the temperature gradient around the loop. Chemical analyses of Nb–1 Zr alloy specimens that supported PWC-11 alloy specimens in boiler and condenser loop sections indicated no evidence of carbon transfer across 0.008–0.020 inch liquid or liquid-vapor gaps. Design and fabrication work was continued in preparation for tests of T-222 alloy in 1430°C lithium and of potential turbine and bearing materials in boiling potassium. A possible correlation between time-to-failure and migration of a tin-rich phase through the silicide layers was indicated by studies of PWK-5 coating constituent distribution as a function of time in 1100°C air. Reliability study of PWK-5 coated Nb–1 Zr alloy demonstrated a mean life of 820 hours in 1100°C air. Niobium diboride surface layers on Nb–1 Zr alloy adversely affected the performance of PWK-5 coating. Measurements of the interaction between aluminide base coatings and niobium base alloys at 1100°C for periods to 5000 hours were completed. The Nb–1 Zr–0.1 C alloy contaminated with at least 2800 ppM oxygen can be heat treated to prevent classical lithium attack. Oxygen in this alloy appears to be closely associated with the carbide phase. The oxygen stabilization reaction in Nb–1 Zr alloy, $Zr-O + O \rightarrow ZrO_2$, was shown to be reversible by internal friction analyses. Capsule corrosion tests of oxygen contaminated Ta–8 W–2 Hf alloy showed generally good compatibility with 1000°C lithium. Heat treatment at 1200°C before lithium exposure has been shown to form an intergranular compound tentatively identified as a tungsten rich oxide which is corroded by the alkali metal. Preliminary data indicate that hydrocarbon gases are evolved from hydrolysis of carbon-contaminated sodium. The 3000-hour compatibility tests were completed. Extrapolation to 10,000 hours showed that of all the beryllium couples tested, only the silver–beryllium combination could be expected to react to thicknesses less than one mil at 760°C. At 650°C, silver, tungsten, tantalum, molybdenum, Nb–1 Zr, vanadium and possibly chromium reactions with beryllium would probably be less than one to two mils in depth after 10,000 hours. Preliminary x-ray data suggests that the failure of silver-joined specimens of beryllium/Nb–1 Zr and beryllium/316 stainless steel, during heating at 760°C for 800 hours, may be associated with the formation of gamma phase (Ag/Be) and brittle niobium or iron beryllide phases. Compatibility tests were initiated at 650 and 705°C on brazed specimens of beryllium/Nb–1 Zr and beryllium/316 stainless steel. Good diffusion bonds were formed between silver and beryllium. No other material was found to be satisfactory. (auth)

7284 SOVREMENNOE SOSTOYANIE VYSOKOTEMPERATURNOI METALLOGRAFII. (Present States of High-Temperature Metallography). Lozinskii, M. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). 152p.

Of the 19 papers, two are within NSA scope and are abstracted separately. (DLC)

For abstracts of individual papers see: 7342 and 7343.

7285 PRESENT SITUATION OF REFRACTORY METALS AND ALLOYS FOR USE IN NUCLEAR ENERGY. II. Present Situation and Future Prospect of Refractory Metals and Alloys. Maeda, T. (Kawasaki Heavy Industries, Ltd., Kobe, Japan). FAPIG (Tokyo); No. 67, 166-179; 204(Nov 1972).

Problems to be considered by designers in order to select serviceable metals and alloys are reviewed and discussed in this chapter (II), together with the present situation of the metals and alloys useful for HTGCRs and heat exchangers, which are indispensable prerequisite for planning a plant system for manufacturing iron, as described in a previous chapter (I). Six subjects are discussed: problems in the boundary between the requirements of design and the development of materials, problems in the characteristics of selected refractory alloys and serviceability as heat-resistant materials for HTGCRs, alloys stronger than the four selected alloys, permeability of hydrogen within the refractory alloys, corrosion by the action of helium gas at high temperature, and conclusion. As the conclusion, (1) the mechanical strength at elevated temperature is incompatible with the corrosion resistance and impermeability of hydrogen, so that an equilibrium point in this antinomic properties shall be found; (2) the materials which can be utilized in other industries, such as Incoloy 807, one grade higher than the selected four alloys, shall be selected at the beginning; (3) construction shall be so designed as to be able to select corrosion-resistant and hydrogen-impermeable materials, even sacrificing the mechanical strength to a certain extent; and (4) tactical non-logical countermeasure may be required in the course of making the materials for practical use at 1,000°C. (JA)

Corrosion and Erosion

Refer also to abstract 6088.

7286 (AECL-4651) STUDY OF ZIRCONIUM ALLOY CORROSION PARAMETERS IN THE ADVANCED TEST REACTOR. Johnson, A. B. Jr.; LeSurf, J. E.; Proebstle, R. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Feb 1974. 31p. Dep. NTIS (US Sales Only) $4.75. AECL $1.00.

The influence of nuclear radiation on zirconium alloy corrosion in oxygenated and deoxygenated coolants was studied in the new North (1D) loop of the Advanced Test Reactor. Fissile contaminants were minimized by performing the corrosion tests before any fuel tests were attempted in the loop, to try to distinguish the role of oxygen from that of fission products. It was found that fissile contaminants are not necessary to produce accelerated corrosion of zirconium alloys under neutron radiation; oxygen plus radiation is sufficient. (auth)

7287 (AECL-4662) CORROSION OF Zr_3Al-BASED ALLOYS BY CARBON DIOXIDE AND A CARBON DIOXIDE–WATER VAPOUR MIXTURE. Part 1. The Kinetics and Their Practical Implications. Cameron, D. J.; Unger, A. E. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Feb 1974. 26p. Dep. NTIS (US Sales Only) $4.50. AECL $1.00.

Samples of Zr_3Al-based alloys containing 7.4 to 9.6% Al have been exposed to flowing commercial purity CO_2 at 673, 698, and 723°K for up to 179 days. After an initial period with a decreasing rate of weight gain the oxidation rates become linear. It is concluded that at 673°K the oxidation rates of alloys containing more than 8.5% Al are such that the corrosion allowance which must be incorporated into the design wall thickness of a pressure tube operating at this temperature, while surrounded by CO_2, is acceptable. The temperature dependence of the oxidation rate of Zr_3Al-based alloys is much greater than that observed for Zr-2.5%Nb and Zircaloy-2, which indicates that the corrosion allowance required on the exterior of a water-cooled reactor pressure tube should be very small. In the 673°K experiments saturation of the CO_2 by water vapor at room temperature increased the rate of weight gain of the alloys by a factor of 3.2 to 4.3. However, the CO_2 used in this part of the test had a higher oxygen content than that used in the dry CO_2 experiments. (auth)

7288 (WARD-NA-3045-9) SODIUM TECHNOLOGY PROGRAM. Progress Report for Period Ending January 31, 1974. Ray, W. E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Apr 1974. Contract AT(11-1)-3045. 100p. AT.

Research and development progress is reported on properties of materials for use in Na-cooled systems. Results of work on friction and wear, materials self-welding, duct load pad materials evaluation, and interstitial transfer in Na containment materials are summarized. (JRD)

7289 OXIDATION OF 9%–Cr STEEL IN CARBON DIOXIDE ATMOSPHERE. 9%–Cr Steel as a Material for AGR Boilers. Kubota, N. (Fuji Electric Co., Ltd., Tokyo). FAPIG (Tokyo); No. 69, 13-15(May 1973). (In Japanese).

It is noted that the Hinckley point B power plant faces two difficult problems, one is the evaluation of temperature limit for 9%–Cr steel, and the other is developing countermeasures to boiler stresses. Oxidation of 9%–Cr steel may accelerate corrosion dur-

ing the predetermined 30 years life, unless the upper temperature limit is lowered. The problem exists in the highest temperature portion of boiler tubes and support straps around their periphery. Measurement of time to breakaway, that is the inflection point on weight gain curves, and the evaluation of postbreakaway rate is carried out on samples under operation conditions. The time to reach this temperature limit is to be determined by linear weight gain rate in carbon steel because the data is not available for the 9%–Cr steel. Experiments are in progress to determine the post-breakaway rate by putting 9%–Cr steel samples in which the breakaway was caused by high temperature acceleration test in autoclaves under regular test condition. A similar test has been performed. The experiment results revealed that average oxidation weight gain at the point of beginning breakaway was 20 mg/cm², and 90% confidence limit was 15 mg/cm². A new limit temperature was determined as 435°C, taking reactor life and dispersion in the temperature of boiler tubes into consideration. A new design is believed to be safe under the new limit conditions, regardless of Hinckley countermeasure. (JA)

7290 SIMULTANEOUS SIMS AND EID INVESTIGATION ON THE INTERACTION OF OXYGEN WITH A W(100) SURFACE. Benninghoven, A.; Loebach, E.; Plog, C.; Treitz, N. (Univ., Cologne). Surface Sci.; 39: No. 2, 397-404(Sep 1973).

A uhv system, containing a heatable tungsten ribbon target (showing [100] planes), an ion source (Ar^+, 2 keV) with mass separator, an electron source (300 eV), a quadrupole secondary ion mass filter, and a quadrupole gas analyzer is used for the study of the interaction of O_2 with W (100) by simultaneous, i.e., fast interchanging, "static" SIMS (secondary [ion-induced] ion mass spectrometry) and EID (electron-induced [ion] desorption). Two different adsorptive binding states can be distinguished: β_2 and β_1. The O^+ emission cross section under electron bombardment from the β_2 state is smaller by a factor of about 10^3 than from β_1 and is found to be temperature-dependent. After the state β_2 has been saturated and before the occupation of β_1 begins, an oxide formation process starts. This oxidation can be interpreted by a two-stage model. (auth)

7291 INVESTIGATION OF SURFACE REACTIONS BY THE STATIC METHOD OF SECONDARY ION MASS SPECTROMETRY. III. The Oxidation of Vanadium, Niobium, and Tantalum in the Monolayer Range. Meuller, A.; Benninghoven, A. (Univ., Cologne). Surface Sci.; 39: No. 2, 427-436(Sep 1973).

By means of the static method of secondary ion mass spectrometry, the oxidation of a polycrystalline vanadium, niobium, and tantalum surface, cleaned by ion bombardment, was investigated in the oxygen dose range up to 1000 L at room temperature. Two different oxide phases with different sputtering rates were found, one covering the other. (10 fig.) (auth)

7292 BINDING ENERGY OF TRANSITION ATOMS ADSORBED ON TUNGSTEN. Bruneel, C.; Allan, G. (ISEN, Lille Cedex, France). Surface Sci.; 39: No. 2, 385-396(Sep 1973).

A statistical method was developed to estimate the density of states from the knowledge of its first moments. This method was applied to the calculation of the density of states of an s band in a simple cubic lattice and used to determine the binding energy of a transition atom adsorbed on tungsten in a LCAO approximation. The binding energies obtained agree with the experimental values, but they do not exhibit the experimental peak which may be due to correlation effects. (10 fig.) (auth)

7293 TRIBO-ELLIPSOMETRIC STUDY OF REPASSIVATION KINETICS OF A Ti–8Al–1Mo–IV ALLOY. Ambrose, J. R.; Kruger, J. (National Bureau of Standards, Washington, DC). J. Electrochem. Soc.; 121: No. 5, 599-604(May 1974).

The tribo-ellipsometric technique allows one to distinguish between film growth and other reactions that occur after removal of a film from a metal surface in a given environment. This technique was used to study the relationship between repassivation kinetics and stress corrosion cracking (SCC) susceptibility for Ti 8Al–1Mo–IV alloy. The effect of the rate of film growth on the amount of metal dissolution which occurs during the repassivation process was investigated by comparing the repassivation transient behavior in a 1.0N NcCl solution, where cracks have been found to propagate, to that in a 1.0N $NaNO_3$ solution where SCC susceptibility has never been detected. Film growth kinetics in both solutions were consistent with a Fleischmann-Thirsk mechanism of oxide patch nucleation and two-dimensional growth, although the film growth rate was significantly slower in the 1.0N NaCl solution. Low film growth rate led to an increase in metal dissolution in a solution where crack propagation velocities have been measured, but at an apparent rate slower than necessary to propagate such cracks by metal dissolution alone. (8 figures) (auth)

7294 KORROZIYA METALLOV. (Corrosion of Metals). Varypaev, V. N. Leningrad; Izdatel'stvo Leningradskogo Universiteta (9172). 87p.

This textbook consists of two sections. The first section contains material on the principles of metal behavior. Primary regularities are given on metal crystallization and methods of investigating and changing metal structure. Typical phase equilibria in binary alloys are considered. The relation of phase diagram with alloy properties is indicated. The second section deals with metal corrosion and methods of protecting metals from corrosion. Types of corrosion are classified. Methods of investigating and estimating corrosion are described. Consideration is given to the theoretical assumptions of electrochemical corrosion, the effect of external and internal factors on corrosion rate, and characteristic features of the most common types of electrochemical corrosion. In considering types of chemical corrosion, primary attention is devoted to gas corrosion. Variants of electrochemical protection and also treatment of the corrosive medium are singled out among the methods of corrosion protection. (SJR)

7295 COADSORPTION OF ELECTROPOSITIVE AND ELECTRONEGATIVE ELEMENTS. I. Cs and H_2 on W(100). Papageorgopoulos, C. A.; Chen, J. M. (Franklin Inst., Swarthmore, PA). Surface Sci.; 39: No. 2, 283-312(Sep 1973).

A systematic experimental study of Cs and Cs–H_2 adsorption on W(100) surfaces by LEED and work function measurements was made. It was found that at high coverages, the electropositive and electronegative adsorbates formed a double layer. The arrangement of the adsorbates was independent of the sequence of deposition. The two adsorbates affected the structures of each other: a Cs layer caused an increase in ordering and binding energy of H on W and the existence of H on W (100) caused an increase in the maximum density of Cs atoms that can be deposited on the surface. This increase in Cs density was accompanied by an increase in work function. The coverage of Cs at the work function minimum was also shifted to a smaller value with increasing amount of initially adsorbed H_2. The work function result was compared with a recent nonuniform electron gas theory of work function. The adsorption of H_2 on Cs-covered W was found to be an activated process and the sticking coefficient decreased exponentially with increasing Cs coverage. It appears that adsorption of Cs did not form a duolayer on W (100), as reported by MacRae et al.; rather it formed a single layer on top of some patches of hydrogen impurity. The small amount of H impurity was not ordered unless there was a layer of Cs on top. (16 fig, 43 references) (auth)

7296 INTERACTION BETWEEN URANIUM SULFIDES AND OXYGEN. Paljevic, M.; Ban, Z.; Despotovic, Z.; Omejec, L. (Univ., Zagreb). J. Nucl. Mater.; 50: No. 2, 200-206(Mar 1974).

Study of the oxidation of uranium monosulfide shows that certain phenomena occur at 350 to 380, 480, and 720°C. In the temperature range 350 to 380°C, an intensive incorporation of oxygen begins, accompanied by loss of SO_2 and S. Simultaneously $UO_{2+0.45}$ and UO_2SO_4 are formed. As the temperature increases, the amount of sulfur remains constant and only oxygen is incorporated. At 540°C the x-ray pattern of the product corresponds to that of U_3O_8, but the composition is $UO_{3.50} + UO_2SO_4$. At higher temperatures the remaining sulfur is burned and U_3O_8 is obtained. The reaction between uranium disulfide and oxygen proceeds in a similar way, except that at 345°C preferential oxidation of sulfur occurs. Investigation of the isothermal oxidation of US and US_2 at temperatures 250 to 305°C and under an oxygen pressure of 400 torr shows that the rate law is initially exponential (lateral growth of oxide film), and that it later becomes parabolic (diffusion of oxygen through the oxide layer). (auth)

7297 MECHANISM FOR IN-REACTOR OXIDATION OF ZIRCONIUM ALLOYS FROM OXIDE ELECTRICAL CHARACTERISTICS. I. Zircaloy-2. Shirvington, P. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Nucl. Mater.; 50: No. 2, 183-199(Mar 1974).

A molten nitrate/nitrite eutectic has been used for studying the electrical characteristics of irradiated zirconium oxides (and unirradiated controls) grown under conditions producing accelerated oxidation of zirconium at 295°C. Oxygenated water in a region of fast neutron flux (1.5×10^{13} n/cm^{-2}/s^{-1}) and oxygenated water accompanied by fluoride contamination of specimens were two such conditions. Tafel analysis of current–voltage curves yielded oxide growth rates which were in reasonable agreement with weight-gain data. Results indicated that accelerated oxide growth was due to an increase in the ease of solid-state oxygen ion diffusion and the shortening of pathways for such diffusion when water enters the finely porous oxide. Such oxides were found to contain up to 3 wt % water. Electronic conduction, which most likely occurred through intermetallic precipitates and other flaws, was relatively unaffected by radiation. (auth)

7298 TENSILE AND CORROSION BEHAVIOR OF ORDERED Zr_3Al-BASED ALLOYS. Schulson, E. M. (Atomic Energy of Canada Ltd., Chalk River). J. Nucl. Mater.; 50: No. 2, 127-138 (Mar 1974).

Polyphase alloys based on ordered Zr_3Al($L1_2$ type) have been deformed in tension at 20 to 600°C and exposed to moist air (300°C), pressurized water (300°C) and atmospheric pressure steam (400°C). Certain alloys display a uniform elongation of 25 to 30% before failure, an ultimate tensile strength at 300°C 160,000 psi, and an oxidation rate of 1.2 mg/dm²/day in atmospheric steam at 400°C. For good ductility a requirement is the absence (or at least a fine distribution) of Zr_2Al, an intermetallic phase which may remain following the transformation $Zr + Zr_3Al \rightarrow Zr_2Al$. Similarly, a requirement for corrosion resistance is the absence (or at least a fine distribution) of the highly corrodible α-Zr(Al) phase. At low temperatures yield appears to be controlled by long-range, internal stresses. Failure occurs suddenly, suggesting that a critical fracture stress exists. (auth)

7299 METHOD FOR PRODUCTION OF UNIFORM MICROSPHERES. Fulwyler, M. J. (to United States Atomic Energy Commission). US Patent 3,790,492. 5 Feb 1974. Filed date 11 Mar 1971. 4p.

Uniform microspheres having any desired diameter within the range of about 2 to 40 microns are readily produced by introducing a laminar jet of a core liquid carrying material in solution or suspension within a laminar flowing sheath liquid. The core liquid jet is periodically disturbed, allowing the droplets of core liquid thus produced to remain suspended within the sheath liquid for a time sufficient for the material suspended or dissolved in the droplets to form condensed microspheres. The periodic disturbances also serve to remove the microspheres from the sheath liquid. The variation in diameter of the microspheres is about 2%, which is near the accuracy limitation of the measuring instrumentation. (Official Gazette)

7300 OXYGEN DIFFUSION IN BETA ZIRCALOY DURING STEAM OXIDATION. Pawel, R. E. (Oak Ridge National Lab., TN). J. Nucl. Mater.; 50: No. 3, 247-258(Apr 1974).

Analytical and finite-difference methods developed to deal with diffusion in finite systems with moving boundaries were used to compute oxygen concentration profiles in the beta phase of Zircaloy specimens oxidized in steam. The results for isothermal exposures at temperatures from 927 to 1371°C are presented and discussed in terms of the properties and observations from a previously reported experimental data set. The computational results furnish a basis for the argument that the (prior) beta phase oxygen content and distribution may contribute significantly to the observed mechanical properties of Zircaloy specimens. The application of the computational methods was also extended to the case of oxygen diffusion in beta Zircaloy during non-isothermal temperature excursions. The exact shapes of the resulting profiles in these cases were shown to be dependent not only upon the shape of the temperature transient, but also upon the specific model chosen to represent the $\beta-\alpha$ transformation behavior during cooling. (auth)

7301 KINETICS OF THE CARBURIZATION–DECARBURIZATION PROCESS OF AUSTENITIC STAINLESS STEELS IN SODIUM. Snyder, R. B.; Natesan, K.; Kassner, T. F. (Argonne National Lab., IL). J. Nucl. Mater.; 50: No. 3, 259-274(Apr 1974).

A mathematical analysis for the carburization–decarburization kinetics of austenitic stainless steels in high-temperature flowing sodium has been developed that incorporates (1) the thermodynamic and kinetic information for carbon in the alloys, (2) the thermal-mechanical treatment of the material (solution-annealed versus cold-worked) which influences the microstructure, and (3) the carbon concentration in sodium and its dependence on sodium-system parameters. Carbon concentration–distance profiles in Types 304 and 316 stainless steel were generated as a function of time, temperature, and carbon concentration in sodium and compared with experimental data. The analysis was used to evaluate the carburization–decarburization behavior of Type 316 stainless steel fuel cladding exposed to sodium and to develop carbon-diffusion profiles in Type 304 stainless steel intermediate heat-exchanger piping upon exposure to primary and secondary system sodium for periods to 30 y. (auth)

Preparation and Fabrication

Refer also to abstracts 5932 and 7239.

7302 (BARC/I-223) STUDIES ON THE RECOVERY OF TUNGSTEN FROM TUNGSTEN ALLOY SCRAP AND CARBIDE RESIDUES. Gokhale, V. W.; Gupta, S. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 14p. INIS.

Tungsten is a material of strategic importance. In the absence of any notable deposits of tungsten in the country and the high cost of the ores, it is necessary to recover tungsten from the heavy-alloy scrap containing 90% or more of tungsten, and the grinding residues from the tungsten carbide industry containing 70 to 75% tungsten as carbide. Substantial quantities of the metal can be recovered from these sources. A comparative study has been made of methods for recovering the metal and they are discussed. (INIS)

7303 (N-73-22420) BRAZING OF BERYLLIUM FOR STRUCTURAL APPLICATIONS. Final Report. Vogan, J. W. (Solar, San Diego, Calif. (USA)). 1972. Contract NAS8-28029. 31p. (NASA-CR-124228). NTIS $3.75.

Progress made in fabricating a beryllium compression tube structure and a stiffened beryllium panel is reported. The compression tube was 7.6 cm in diameter and 30.5 cm long with titanium end fittings. The panel was 203 cm long and stiffened with longitudinal stringers. Both units were assembled by brazing with BAg-18 braze alloy. The detail parts were fabricated by hot forming 0.305 cm beryllium sheet and the brazing parameters established. (auth)

7304 STUDY OF THE PREPARATION OF ATOMICALLY CLEAN TUNGSTEN SURFACES BY AUGER ELECTRON SPECTROSCOPY. Joyner, R. W.; Rickman, J.; Roberts, M. W. (Univ. of Bradford, Eng.). Surface Sci.; 39: No. 2, 445-449(Sep 1973).

An Auger electron spectroscopic study was made of the cleaning of W by heating in O_2 to remove C. Results show that in order to remove C, the sample must be below 2000°K so that much of the C exists at the surface. 1 h in O_2 at 1×10^{-7} torr at 1500°K results in a carbon-free surface; prolonged heating up to 100 h reduces the C content. The O_2 could be removed in 5×10^{-7} torr H_2. Exposure of a clean W surface at 300°K to an electron beam led to C accumulation. (DLC)

7305 LANGMUIR CLOSED CYCLE PROCESS AS A TRANSPORT MECHANISM FOR THE GROWTH OF TUNGSTEN SINGLE CRYSTALS IN FORMING GAS (80% N_2, 20% H_2). Prager, M. (Univ., Tuebingen, Ger.). J. Cryst. Growth; 22: No. 1, 6-12(Mar 1974). (In German).

Tungsten monocrystals grow on tungsten tips welded to the tungsten hairpin filament of the type used in electron microscopes when they are heated in a gas mixture of 80% N_2 and 20% H_2 in presence of traces of HEO vapor. This growth is shown experimentally to be due to a transport mechanism based on Langmuir's closed cycle ($W + 3H_2O \rightleftharpoons WO_3 + 3H_2$). At the hot regions of the filament (2500°C) gaseous WO_3 is formed which diffuses through the gas at a pressure of 10^3 Pascals to the tip (2200°C) where it is reduced to metallic W. By using extremely pure H_2 and N_2 gas and by adding defined quantities of H_2O the transport mechanism $W + N_2 \rightleftharpoons WN_2$ suggested by v. Grote is shown to be of no importance. If the content of water vapor is high and the temperature of the W tip too low, dendrites and many small crystallites are formed due to the smaller surface mobility of the tungsten atoms and the large supply of material. (auth)

7306 STUDY OF THE PROCESS OF FORMING AN ALLOY DURING THE SIMULTANEOUS THERMIC-MAGNESIUM REDUCTION OF TITANIUM AND MOLYBDENUM CHLORIDES. Reznichenko, V. A.; Moinov, S. G.; Makarov, S. B.; Ivanov, A. N.; Orlova, N. V. Izv. Akad. Nauk SSSR, Metal.; No. 1, 27-30(1974). (In Russian).

Results are given in studying alloy formation during the simultaneous reduction of Ti and Mo chlorides with subsequent vacuum separation of the reacting masses at 850°C (partial separation of phases) and at 1000°C (full separation). X-ray analysis was used in phase determinations. The $\alpha-Ti$ solution is formed directly as a result of reduction. Prolonged holding of the reaction mass at 800–850°C after reduction does not change the phase composition of the resulting metal. Apparently particle of a bcc solid solution and $\alpha-Ti$ are separated from each other by layers of magnesium metal which impede the diffusion equalization of concentration. After a complete vacuum separation it was found that the main phase was a bcc solid solution with a period a = 3.214 Å which corresponds to a solution of 35% Mo in titanium. Lines of the β-solid solution are very diffuse. With vacuum filtration there is mutual solution of the phases formed during reduction with formation of an alloy of given composition. (SJR)

7307 CERTAIN PROBLEMS IN NIOBIUM PURIFICATION DURING REDUCTION OF $NbCl_5$ WITH HYDROGEN. Abramov, V. V.; Petrusevich, I. V.; Firsov, V. I.; Vozhzhov, V. F.; Nisel'son, L. A. Izv. Akad. Nauk SSSR, Metal.; No. 1, 34-38(1974). (In Russian).

The fate of W, Ta, Al, and Ga impurities in the starting $NbCl_5$ was investigated. The content of W or Ta was determined by neu-

tron activation analysis. It was found that the content of Ta decreased from 3.14×10^{-2} wt % to 1.80×10^{-2} wt % during hydrogen reduction, and the concentration of W decreased from 1.02×10^{-2} wt % to 2.23×10^{-3} wt %. The separation factor was found to be 60 with 2 mol % aluminum trichloride in the initial niobium chloride. The separation factor falls to 8 on increasing the concentration of $AlCl_3$ to 10 mol %. The separation factor was 32 with 2 mol % $GaCl_3$ in the $NbCl_5$ with the separation factor decreasing with increasing concentration of gallium trichloride in the initial niobium pentachloride. Niobium can be purified from small amounts of Ta, W, Al, and Ga during hydrogen reduction. (SJR)

7308 BEHAVIOR OF IMPURITIES IN CADMIUM DURING VACUUM DISTILLATION. Zydov, V. G.; Aleksandrov, B. N. Izv. Akad. Nauk SSSR, Metal.; No. 1, 43-47(1974). (In Russian).

A study was carried out on the effectiveness of vacuum distillation in removing impurities from cadmium metal. The removal of nine impurities (Ag, Cu, Sn, Bi, Pb, Sb, Tl, Zn, and As) was followed as a function of the content in the initial cadmium (0.001, 0.01, 0.1, and 1.0%) and as a function of the distillation pressure. The cadmium metal was distilled from a 100-liter vacuum vessel equipped with a heated condenser with a temperature of 260°C in the lower part and 160°C in the upper part of the condenser. The evaporation rate was 18.5 to 20 $g/cm^2 \cdot h$ at a residual pressure of 2×10^{-2} mm Hg std with 70% of the cadmium metal being evaporated and 30% being left behind. Cadmium was readily purified from the first seven impurities (Ag, Cu, Sn, Bi, Pb, Sb, and Tl), but hardly any purification from As and Zn could be observed. In log coordinates, the separation factors for the impurities are directly proportional to the initial concentration of impurity in the cadmium metal. Increasing the vacuum from 6×10^{-2} to 2×10^{-2} mm Hg std increases the evaporation rate from 16.5 to 20 $g/cm^2 \cdot h$, and also improves the removal of impurities. (SJR)

7309 PROCESS FOR MANUFACTURING ROUGH WORKED PARTS. Decours, J.; Frenkel, J. M.; Gavinet, J.; Segurens, L.; Weisz, M. (to Commissariat a l'Energie Atomique). French Patent 2,142,267. 18 Jun 1971. 4p. (In French).

A process is described for manufacturing rough-worked noncubic structured parts capable of undergoing phase transformations. In this process, the following stages are successively effected: melting, boring, and tempering in the β phase region in view of extruding. These rough-worked parts are made of one of the following metals; hafnium, titanium, zirconium, or one of their alloys in particular: Zircaloy. (FR)

7310 ELECTRON BOMBARDMENT WELDING IN NUCLEAR REACTOR TECHNOLOGY. Diaz Diaz, J. L. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 17: No. 84, 283-296 (1973). (In Spanish).

After a brief review of the history of the electron gun, its components and operation and its application to welding are discussed. The effects on the basic welding parameters are considered. The complete apparatus for electron bombardment welding and its operation are described. The importance of welding in reactor technology and the specific problems solved by the use of electron welding are discussed. (13 figures) (tr-auth)

7311 SPHEROIDIZATION OF GRAIN BOUNDARY PRECIPITATES. Jones, R. H.; Parker, E. R.; Zackay, V. F. (to United States Atomic Energy Commission). US Patent 3,794,532. 26 Feb 1974. Filed date 14 Mar 1972. 6p.

A method is described for spheroidizing grain boundary precipitates by cycling through the alpha-gamma phase transformation, wherein both the ductility and strength of the material are increased. The inventive spheroidization process is applicable to the binary system, such as Fe-Ta. In addition, it has been discovered that the addition of selected amounts of chromium on the Fe-Ta binary system (Fe-Ta-Cr alloy) enhanced spheriodization as well as improved oxidation resistance, while lowering the heat treatment temperature. (Official Gazette)

7312 METHOD OF INTRODUCING RARE EARTH METALS INTO ADDITION ALLOYS. Church, N. L.; Schelleng, R. D. (to International Nickel Co., Inc.). US Patent 3,801,311. 2 Apr 1974. Filed date 24 Jan 1973. 8p.

A method is provided for preparing alloys comprising nickel, magnesium, and rare earth metals in which rare earth oxides are used as the source of the rare earth metals. The rare earth oxides are added to nickel-magnesium melts which contain at least about 35% magnesium. The resultant alloys may be tailored to produce alloys suitable for treating cast iron melts. (Official Gazette)

7313 RESIDUAL GAS ANALYSIS STUDIES DURING SPUTTERING OF REACTIVE METALS. Meyer, D. E. (Manufacturing Process Laboratory, Semiconductor Circuits-QRA, Dallas, Texas 75222). J. Vac. Sci. Technol.; 11: No. 1, 168-173(Jan 1974).

Presence of residual gases in a sputtering discharge can alter the properties of sputtered films of molybdenum, titanium, palladium, titanium-tungsten, chromium, and similar reactive metals. Of particular interest are hydrogen and water vapor. In this article, equipment and methods are described and discussed which permit direct and real time analysis of residual gases during sputtering processes. In a production system argon may constitute as little as 59% of a total pressure of 10 μ. Two major sources of residuals are dirty systems and poorly manufactured targets. Diffusion pump, turbopump, and ion-pump systems were monitored. (auth)

7314 VACUUM ARC MELTING OF TUNGSTEN-HAFNIUM-CARBON ALLOY. Ammon, R.L.; Buckman, R.W. Jr. (Westinghouse Astronuclear Laboratory, Pittsburgh, Pennsylvania 15236). J. Vac. Sci. Technol. 11: No. 1, 385-388 (Jan 1974).

The vacuum arc casting of tungsten alloys, which contain carbon as an alloy addition, require special melting procedures in order to produce melts of consistent controlled levels of alloy content. A melting procedure will be described in which elemental components of a tungsten 0.35% HfC alloy are assembled to form an electrode for ac vacuum arc melting to produce 3-in.-diam ingots. Melting procedures and analytical chemistry are discussed and compared with data for ingots produced by other techniques. (auth)

7315 PROPERTIES OF MOLYBDENUM FILMS PREPARED BY DECOMPOSITION OF THE CARBONYL. DeRosa, A.I.; Dove, D.B.; Loehman, R.E. (Department of Materials Science and Engineering, University of Florida, Gainesville, Florida 32611). J. Vac. Sci. Technol. 11: No. 1, 455-457 (Jan 1974).

Results of research directed toward preparation of refractory metal electrodes for amorphous chalcogenide semiconductors are presented. $Mo(CO)_6$ vapor in Ar carrier gas was pyrolytically decomposed at temperatures below 250 °C to form a low-resistance metallic coating on selected substrates. X-ray and electron diffraction experiments indicated these films are amorphous. Heat treatment for 15 min at 865 °C promoted crystallization of the deposits; x-ray analysis then showed the presence of Mo and Mo_2C in a 2 : 1 ratio. Masking techniques to produce particular electrode configurations were only partially successful; however, a photolithographic method produced electrodes completely satisfactory for electrical-properties measurements. (auth)

7316 ANALYSIS OF AN $Ar-O_2-N_2$ DISCHARGE FOR TANTALUM SPUTTERING. Westwood, W.D. (Bell-Northern Research, Ottawa, Canada). J. Vac. Sci. Technol. 11: No. 1, 175-178 (Jan 1974).

Both optical-emission spectroscopy and mass spectrometry have been used to investigate the species present in an $Ar-O_2-N_2$ glow discharge when tantalum is being sputtered. Special attention has been focused on the conditions under which a decrease in film resistivity is produced by an appropriate N_2 flow. The addition of oxygen caused a significant increase in the nitrogen emission but no oxygen emission was observed. The oxygen is gettered more efficiently by the tantalum than is nitrogen so that more nitrogen reaches the center of the discharge when O_2 is added. For the same flowrates of N_2 and O_2, the N_2 signal measured by the differentially-pumped mass spectrometer is about 100 times the O_2 signal. The changes observed in the electrical and structural properties of the films as the O_2 flow was increased are consistent with an increase in nitrogen concentration in the films. When the N_2 flow was adjusted to give a resistivity of 100$\mu\Omega$ cm in the absence of O_2, ρ increased to 250 $\mu\Omega$ cm with increasing O_2 flow but the films retained the bcc structure. In the absence of N_2, the resistivity was independent of O_2 flows below a critical level. No evidence for the formation of an oxide of nitrogen was obtained. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 7279, 7929, 8318, 8449, 8787, and 8845.

7317 (AD-769129) DISLOCATION VELOCITY MEASUREMENTS IN HIGH-PURITY NIOBIUM. Walson, R. P.; Birnbaum, H. K. (Illinois Univ., Urbana (USA)). Oct 1973. 140p. NTIS $4.50.

The velocity of screw dislocations on (211) planes, mixed dislocations on (101) planes, and mixed dislocations on (211) planes has been investigated microscopically in ultra-high purity niobium single crystals using Berg-Barrett x-ray topographs and chemical etching techniques. The Berg-Barrett x-ray topographic technique was found to be unsatisfactory for resolving individual dislocations or slip lines in the niobium used in this investigation. Chemical etching on the other hand produced satisfactory results and allowed the study of individual dislocations. An asymmetry of the velocity of screw dislocations on (211) planes was observed between a state of compression and a state of tension at room temperature. The screw and mixed dislocation velocities could be described by a power law dependence on stress. (GRA)

7318 (AD-769350) HEAT GENERATION IN COMPOSITE MATERIALS DURING FATIGUE LOADING. Reifsnider, K. L.;

Stinchcomb, W. W.; Williams, R. S.; Marcus, L. A. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). May 1973. 73p. (VPI-E-73-21; AFOSR-TR-73-1961). NTIS $4.00.

Two composite materials, boron-epoxy (B/E_p) and boron-aluminum (B/Al) were monitored during cyclic loading to establish the amount of heat generated by dissipative internal deformation processes. Both the magnitudes and distributions of heat generation were recorded in real time so that heat build up could be correlated with load amplitude, frequency of load oscillation, and damage development. The study of heat generation was carried out using three measurement techniques, liquid crystals, thermocouples, and video-thermography. Temperature increases of 20°F in B/Al and 70°F in B/(E_p) near stress concentration positions were found to be common. Correlations of heat generation with mechanical hysteresis, frequency of load oscillation, and development of damage are established. (GRA)

7319 (AD-769763) HARDNESS, STRENGTH, AND ELONGATION CORRELATIONS FOR SOME TITANIUM-BASE ALLOYS. Houston, W. A.; Jones, T. E.; Abson, D. J.; Gurney, F. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1973. Contract F33615-71-C-1163. 74p. (AFML-TR-73-103). NTIS $3.50.

Previously published results of aluminum-base alloys and steels showed that accurate prediction of yield stress and ultimate tensile stress was possible from hardness data. A study was undertaken to see if the relationships were also obeyed by titanium-base alloys. The intention was to permit exploitation of the economic advantages which would result from a saving in machining cost and in testing time, if the judicious use of hardness testing were to provide data approximately equivalent to that obtained by tensile testing. Rockwell hardness and tensile data obtained in an earlier study on three titanium base alloys (Ti-13V-11Cr-3Al, Ti-5Al-2.5Sn and Ti-6Al-4V) have been augmented with Meyer, Vickers, and Knoop hardness measurements. The tensile data have been analyzed to give the work hardening coefficient. An attempt was also made to estimate points along the tensile curve from Meyer hardness data. (GRA)

7320 (CONF-740606-9) RELATIONSHIP BETWEEN RUPTURE LIFE AND CREEP PROPERTIES OF 2¼ Cr-1 Mo STEEL. Klueh, R. L. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 28p. Dep. NTIS $4.50.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

Empirical relationships between creep and rupture properties for various metals and alloys have been demonstrated. Empirical relations between the rupture life and the minimum creep rate, and the rupture life and the time to the end of steady-state creep (start of tertiary creep) for four heats of normalized-and-tempered 2¼ Cr-1 Mo steel with different carbon contents were investigated. The primary objective was to determine the conditions that affect the correlation. The primary microstructural constituent (proeutectoid ferrite or bainite) of the matrix and the precipitates present in that matrix (before test or formed during test) played a significant role in the correlation of the data with the chosen empirical relation. (auth)

7321 (HEDL-SA-662) FATIGUE-CRACK PROPAGATION BEHAVIOR OF INCOLOY 800 AT ELEVATED TEMPERATURES. James, L. A. (Westinghouse Hanford Co., Richland, Wash. (USA)). Nov 1973. Contract AT(45-1)-2170. 22p. (CONF-740606-7). Dep. NTIS $4.25.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

Linear-elastic fracture mechanics techniques were used to characterize the fatigue-crack propagation behavior of Incoloy 800 over the temperature range 75 to 1200°F. Material Grades 1 and 2 were found to exhibit essentially the same behavior over this range, with some exceptions noted at 1200°F. In general, crack growth rates increased with increasing test temperature, although the increases were less than previously noted for austenitic stainless steels. This difference is probably related to the superior oxidation resistance of Incoloy 800. (auth)

7322 (IAEA-R-626-F) RESEARCH OF NUCLEAR REACTOR PRESSURE VESSEL SAFETY FROM THE POINT OF VIEW OF BRITTLE CRACKS. Final report, 1 July 1968-31 October 1972. Brumovsky, M.; Kalna, K. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. vp. INIS.

Research is reported on operational safety criterion for vessels pressurized by gas, based on the idea that it is possible to determine the temperature at which the propagating crack, either brittle or fast shear, will be arrested. It was found that for pressure vessels and pipelines, pressurized by gas medium, i.e., with high values of accumulated energy, it is possible to find a safety criterion against brittle or fast shear fracture on the basis of temperature approach. (INIS)

7323 (LA-UR-74-657) TENSILE FATIGUE BEHAVIOR OF MOLYBDENUM AT 1153 K. Yeske, R. A.; Green, W. V.; Zukas, E. G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 7p. (CONF-740402-26). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Molybdenum was creep tested at 1153°K under cyclic stress. The stress cycles used were 5 to 170 M Pascals. The log-log plot of engineering strain as a function of time increased linearly until there was an acceleration in creep rate followed by fracture. Metallographic examination showed not only deformation within the grains but also grain boundary cracking. Such behavior is normal also for constant stress creep tests. A comparison of time to rupture for cyclic stress experiment results with published data for constant stress creep tests at essentially the same test temperature showed that the time under cyclic conditions was shorter than it is under constant stress. Additional tests are being done to determine if factors other than cyclic stressing are responsible for this high creep rate. (auth)

7324 (N-73-13514) INFLUENCE OF CREEP DAMAGE ON THE LOW-CYCLE THERMAL-MECHANICAL FATIGUE BEHAVIOR OF TWO TANTALUM-BASE ALLOYS. Final Report. Sheffler, K. D.; Doble, G. S. (TRW Materials Technology Labs., Cleveland, Ohio (USA)). 1 May 1972. Contract NAS3-13228. 125p. (NASA-CR-121001; TRW-ER-7592). NTIS $8.25.

Low-cycle fatigue tests have been performed on the tantalum base alloys T-111 and ASTAR 811C with synchronized, independently programmed temperature and strain cycling. The thermal-mechanical cycles applied fell into three basic categories: these were isothermal cycling, in-phase thermal cycling, and out-of-phase thermal cycling. In-phase cycling was defined as tensile deformation associated with high temperature and compressive deformation with low temperature, while out-of-phase thermal cycling was defined as the reverse case. The in-phase thermal cycling had a pronounced detrimental influence on the fatigue life of both alloys, with the life reduction being greater in the solid solution strengthened T-111 alloy than in the carbide strengthened ASTAR 811C alloy. The out-of-phase tests also showed pronounced effects on the fatigue life of both alloys, although not as dramatic. (auth)

7325 (N-73-31496) GENERATION OF LONG-TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES. Final Report. Sheffler, K. D.; Ebert, R. R. (TRW Materials Technology Labs., Cleveland, Ohio (USA)). Sep 1973. Contract NAS3-15554. 122p. (NASA-CR-134481; TRW-ER-7648). NTIS $8.25.

Four separate studies of various aspects of the vacuum creep behavior of two tantalum alloys (T-111 and ASTAR 811C) and of pure CVD tungsten are reported. The influence of high temperature pre-exposure to vacuum or to liquid lithium on the subsequent creep behavior of T-111 alloy was studied. Results revealed significant effects of pre-exposure on the 1% creep life of T-111, with life reductions of about 3 orders of magnitude being observed in extreme cases. The creep behavior of T-111 was also studied under conditions of continuously increasing stress and decreasing temperature which simulated the conditions anticipated in radioisotope capsule service. Results showed that such test conditions produced a creep curve having a very unusual shape, and led to the identification of a new creep design parameter for this type of service. The third area of investigation was a study of the influence of heat treatment on the microstructure and creep behavior of AS-TAR 811C. The fourth part of the program was directed toward a preliminary characterization of the 1% creep life of CVD tungsten as obtained from two different sources. (auth)

7326 (N-74-11714) ANALYSIS OF FATIGUE, FATIGUE-CRACK PROPAGATION, AND FRACTURE DATA. Final Report. Jaske, C. E.; Feddersen, C. E.; Davies, K. B.; Rice, R. C. (Battelle Columbus Labs., Ohio (USA)). Nov 1973. Contract NAS1-11344. 182p. (NASA-CR-132332). NTIS $11.25.

Analytical methods were developed for consolidation of fatigue, fatigue-crack propagation, and fracture data for use in design of metallic aerospace structural components. To evaluate these methods, a comprehensive file of data on 2024 and 7075 aluminums, Ti-6A l-4V, and 300M and D6Ac steels was established. Data were obtained from both published literature and unpublished reports furnished by aerospace companies. Fatigue and fatigue-crack-propagation analyses were restricted to information obtained from constant-amplitude load or strain cycling of specimens in air at room temperature. Fracture toughness data were from tests of center-cracked tension panels, part-through crack specimens, and compact-tension specimens. (auth)

7327 (N-74-12254) INFLUENCE OF TEMPERATURE ON FATIGUE-CRACK GROWTH IN A MILL-ANNEALED Ti-6Al-4V

ALLOY. Wei, R. P.; Ritter, D. L. (Lehigh Univ., Bethlehem, Pa. (USA)). 29 Jun 1971. 41p. (NASA-CR-111958). NTIS $4.25.

To understand the influence of temperature on the rate of fatigue crack growth in high-strength metal alloys, constant load amplitude fatigue crack growth experiments were carried out using a 1/4 inch thick (6.35 mm) mill-annealed Ti-6Al-4V alloy plate as a model material. The rates of fatigue crack growth were determined as a function of temperature, ranging from room temperature to about 290°C and as a function of the crack tip, stress intensity factor K, in dehumidified high-purity argon environment. The dependence of the rate of fatigue crack growth on K appears to be separable into two regions. The transition correlates with changes in both the microscopic and macroscopic appearances of the fracture surfaces, and suggests a change in the mechanism and the influence of microstructure on fatigue crack growth. (auth)

7328 (N-74-13245) DEVELOPMENT OF DUCTILE HIGH-STRENGTH CHROMIUM ALLOYS, PHASE 2. Final Report. Filippi, A. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1973. Contract NAS3-15559. 78p. (NASA-CR-134522; WANL-M-FR-73-5). NTIS $6.00.

Strength and ductility were evaluated for chromium alloys dispersion hardened with the putative TaC, TaB, NbC, and NbB compounds. TaC and TaB proved to be the most potent strengtheners, but when combined, their effect far outweighed that produced individually. Tests at 1422°K on an alloy containing these two compounds at the combined level of 0.5 mole % revealed a 495 MN/sq m (70 ksi) tensile strength for wrought material, and a 100-hour rupture strength of 208 MN/sq m (30 ksi) when solution annealed and aged to maximize creep resistance. These levels of high temperature strength greatly exceed that reported for any other chromium-base alloy. The ductile-to-brittle transition temperature (DBTT) of the two phase strengthened alloy occurred at approximately 588°K when heat treated to optimize creep strength and was not improved by fabrication to produce a wrought and recovered microstructure. The lowest DBTT measured on any of the alloys investigated was 422°K. Strengthening phases actually formed in Cr-Ta-B and Cr-Nb-B compositions are probable M_2CrB_2 (M = Ta or Nb) compounds of tetragonal crystal structure. The likely habit relationship between these compounds and chromium is postulated. Cube habit coherency was identified for TaC precipitation in Cr by electron microscopy. In another study, the maximum solubility of carbon in Cr was indicated to lie between 3/4 and 1 a/o and that of boron to be <1/2 at. %. (auth)

7329 (N-74-14188) EUTECTIC SUPERALLOYS STRENGTHENED BY SIGMA, Ni_3Nb LAMELLAE AND GAMMA PRIME, Ni_3Al PRECIPITATES. Lemkey, F. D. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). Nov 1973. Contract NAS3-15562. 137p. (NASA-CR-2278; M-911213-5). NTIS $4.50.

By means of a screening and solidification optimization study of certain alloys located on the gamma-sigma liquidus surface within the Ni-Nb-Cr-Al system, alloys with high-temperature properties superior to those of all known superalloys were defined. One alloy, Ni-19.7% Nb-6.0% Cr-2.5% Al, directionally solidified at 3 cm/hr met or exceeded each program goal. A second alloy, Ni-21.75% Nb-2.55% Al, although deficient in its inherent oxidation resistance, met the other program goals and combined a remarkable insensitivity of composite microstructure to solidification parameters with excellent low temperature toughness. This investigation demonstrated that useful properties for gas turbine airfoil application have been achieved by reinforcing a strong and tough gamma solid solution matrix containing precipitated gamma prime by a lamellar intermetallic compound Ni_3 Nb having greater strength at elevated temperature. (auth)

7330 YIELD STRESS AND SLIP ASYMMETRY IN TANTALUM-NITROGEN ALLOYS. Webb, G. L. Cleveland; Case Western Reserve Univ. (1973). 149p. University Microfilms Order No. 74-2574.

Thesis (Ph. D.).

The orientation dependence of both the yield stress and slip systems of pure tantalum and tantalum alloys containing up to ~500 atomic ppM nitrogen was investigated at 77 and 197°K. Oriented single crystals were grown in a zone melter, and purified using a UHV solid state outgassing technique. Specimens with orientations $-30 \leq \chi \leq +30$ (χ being the angle between the maximum resolved shear stress plane and the (011) plane) were tested in tension and compression; slip trace analysis was done on many of the specimens. At 77°K, the yield stress is a minimum when $\chi = -30$, and for any orientation, the yield stress in compression is greater than the yield stress in tension. At 197°K, for an orientation with $\chi = +30$, the strength differential between tension and compression reversed, and the yield stress in tension was greater than the yield stress in compression. The rate of alloy hardening was found to be a strong function of orientation, nitrogen content, and mode of testing (tension or compression). Pure tantalum specimens of most orientations slipped on the (011) plane, but slip was also observed on the twinning {112} plane for specimens tested in compression, and on the anomalous {110} plane for specimens tested in both tension and compression. Slip traces of both the (011) and twinning {112} plane were observed on tantalum-nitrogen alloys. Asymmetry models from four categories (Jog models, Conventional Peierls models, True partial dislocation models, and extended core, pseudo-Peierls models) were studied; the conclusion was that the extended core models best describe the asymmetry of the yield stress and slip systems in tantalum and tantalum-nitrogen alloys. The direction and magnitude of the normal stress on the twinning {112} plane is important at low temperatures, indicating that lattice expansions normal to this plane are important in determining the yield stress. Models attributing the orientation dependence of the alloy hardening rate to orientation dependent interactions between extended core dislocations and interstitials do not predict the observed behavior; however, these models have not considered the effect of a normal stress on these interactions. (Diss. Abstr. Int., B)

7331 EFFECT OF TEMPERATURE AND STRAIN RATE ON PLASTIC INSTABILITY OF TYPE 316 STAINLESS STEEL. Hauser, D. Columbus, OH; Ohio State Univ. (1973). 217p. University Microfilms Order No. 74-3194.

Thesis (Ph. D.).

The effects of important parameters on the activation of plastic instability, which is localization of plastic flow in the directions of pure shear, were evaluated for type 316 stainless steel. Torsion tests were conducted over the temperature range of 27 to 650°C and at shear-strain rates of 0.07 to 4.8 per minute. Prior to test-specimen preparation, the stainless steel was solution annealed, sensitized, or aged at 815°C for 1200 hours. In addition, the gage-section diameter was varied in selected tests in order to evaluate the effects of stress, strain, and strain-rate gradients. The results showed that the shear strain to the onset of plastic instability and the shear strain to fracture were maximum at 260°C. They were largest for solution-annealed material, intermediate for sensitized 316, and least for aged material at each temperature and strain rate. With increasing shear-strain rate, the strain to the onset of localized flow increased and the strain to fracture decreased at each test temperature. The introduction of second-phase particles and reduction of the amount of solute in solid solution in austenite accompanying sensitizing and long-time aging heat treatments are responsible for reductions of the work-hardening rate, strain to instability, strain to fracture, and the tolerance for localized plastic deformation. At the highest test temperature and shear-strain rate, plastic flow and fracture behavior are relatively independent of the initial heat-treatment condition. For all heat-treatment and testing conditions used, fracture occurred in a stable manner, requiring continued plastic deformation for fracture propagation. Fracture initiation involved particle fracture and particle-matrix separation. Fracture propagation occurred by instability coalescence of voids. The development of localized plastic flow and initiation of fracture were relatively insensitive to variations of stress, strain, and strain-rate gradients in the ranges that were studied. The work-hardening rate at the onset of plastic instability appears to be more influential than the values of the gradients. The great tolerance of this alloy for flaws is attributed to its large strain-hardening capacity. A general criterion for the development of plastic instability based on changes of the flow stress is capable of predicting the onset of plastic instability. It was concluded that the combined effects of arc welding, exposure to nuclear irradiation, and long-time thermal aging can significantly reduce the notch toughness and fracture resistance of this alloy in nuclear reactor components. (Diss. Abstr. Int., B)

7332 MICROSTRUCTURAL FACTORS INFLUENCING FRACTURE TOUGHNESS OF HAFNIUM TITANATE. Hoagland, R. G. (Battelle Columbus Labs., OH); Marschall, C. W.; Roenfield, A. R.; Hollenberg, G.; Ruh, R. Mater. Sci. Eng.; 15: 51-62(1974).

The effect of composition and porosity on the strength and toughness of a binary oxide, $HfTiO_4$, was investigated. This material has characteristics such as a near-zero thermal expansivity (in polycrystalline form) arising from a negative expansivity along one of the crystallographic axes, and a large solid solubility range, based on the composition $HfTiO_4$, and extending from around 35 mole % TiO_2 to beyond 50 mole % TiO_2. Strength was measured in 4-point bending while fracture energy was measured on side-grooved double-cantilever-beam (DCB) specimens. Increasing porosity in the range from 12 to 26% had little effect on strength and caused a slight decrease in fracture energy. Compositions in the range from 30 to 40 mole % TiO_2 exhibited lower strengths and greater fracture energies than did compositions containing 45

to 50 mole % TiO_2. A simple microcrack model was developed to rationalize both the fracture strengths observed and the effect of composition. (auth)

7333 EFFECT OF CYCLIC DEFORMATION ON THE DISLOCATION STRUCTURE AND MECHANICAL PROPERTIES OF MOLYBDENUM, CHROMIUM, AND TUNGSTEN. Kovsh, S. V.; Kotko, V. A.; Polotskii, I. G.; Prokopenko, V. I.; Trefilov, V. I.; Firstov, S. A. (Inst. of Metal Physics, Kiev). Probl. Prochnosti; 5: 15-20(Nov 1973). (In Russian).

The effects of low-frequency elastic vibrations on the dislocation structure and mechanical properties of molybdenum, chromium, and tungsten were studied. On the basis of electron-microscope studies, it is shown that under the action of elastic vibrations a cell structure with large disorientation angles (3 to 5°) forms in molybdenum. The average size of the cells is about 2 microns. The formation of a disoriented cell structure during sonic wave loading is also observed in chromium and tungsten. An analysis is made of the variation in the microhardness of the samples after cyclic loading. It is shown that the hardening obtained by cyclic loading of molybdenum at low frequencies is comparable to the hardening obtained during 90% plastic deformation by rolling. (IAA)

7334 MAGNETIC NEUTRON SCATTERING ON MnO NEAR T(N). Leder, H.; Rauch, H. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Atomkernenergie; 22: No. 3, 196-198(Dec 1973).

The elastic and quasielastic magnetic scattering of a MnO single crystal is investigated by means of a double axis spectrometer. After correction for extinction the sublattice magnetization was determined. A best-fit procedure yields T(N) = 121.69 ± 0.06°K for the Neel temperature and $\beta = 0.328 \pm 0.038$ for the critical exponent. The marked quasi-elastic scattering intensity above T(N) was analyzed according to the Gennes and a paramagnetic Curie temperature of theta = −619.5 ± 10°K was determined. (GE)

7335 ADSORPTION OF OXYGEN AND CARBON MONOXIDE BY EVAPORATED FILMS OF TITANIUM AND ERBIUM: ELECTRICAL RESISTANCE AND SURFACE AREA MEASUREMENTS. Singh, B.; Mueller, J.; Surplice, N. A. (Univ. of Keele, Eng.). Thin Solid Films; 21: No. 2, 255-265(Apr 1974).

The increase in electrical resistance of a metal film owing to the chemisorption of a gas has been studied for the systems O_2/Ti, O_2/Er, CO/Ti and CO/Er. The surface area of each film was determined from the physical adsorption of Kr at 78°K. The systems O_2/Er, CO/Ti and CO/Er saturated at about a monolayer but O_2/Ti saturated at the equivalent of 6 to 8 monolayers. The proportionate change of resistance with gas dosage and time was qualitatively very similar for all four systems; consequently the resistance curves cannot be used to distinguish between monolayer chemisorption and chemisorption with incorporation of a gas into the metal lattice. The magnitude of the proportionate change of resistance depended on the geometrical parameters of the films. (auth)

7336 COADSORPTION OF ELECTROPOSITIVE AND ELECTRONEGATIVE ELEMENTS. II. Cs and O_2 on W(100). Papageorgopoulos, C. A.; Chen, J. M. (Franklin Inst., Swarthmore, PA). Surface Sci.; 39: No. 2, 313-332(Sep 1973).

Results were analogous to those of the Cs−H_2 system. Independent of the sequence of deposition, the adsorbates formed a double layer with the oxygen underneath the Cs layer. The presence of Cs caused a transformation of a (4 × 1) structure of O_2 to a c (2 × 2) structure. Cesium also caused submerged oxygen atoms in the crystal to diffuse to the surface. The initially adsorbed O_2 enabled an increase in saturation coverage of Cs. This effect was more drastic in the O_2 case than that found with preadsorbed hydrogen. The presence of oxygen caused an increase in the work function at the saturation coverage of the subsequently adsorbed Cs, and a shift of the Cs coverage at the work function minimum to lower values. But both of these changes were small compared to those found for the Cs + H_2 system. The sticking coefficient of O_2 on Cs covered W (100) was higher than that for O_2 on clean W. This was attributed to an active chemisorption of O_2 on the Cs film and a place exchange mechanism. (2 figures) (auth)

7337 ORDER−DISORDER TRANSFORMATION IN Au_4V. Fuernrohr, P. (Max-Planck-Institut fuer Metallforschung, Stuttgart). (1973). vp.

From international symposium on order−disorder transformation in alloys; Tuebingen, Ger. (3 Sep 1973).

An effect of local atomic arrangement of the physical properties was observed in the Au-V systems Au_4V, as a concentrated alloy of a 3d-metal, undergoes order−disorder transformation below 565°C and exhibits there a marked change in the electric, magnetic and mechanical behavior. To get insight into the ordering kinetics, a series of electrical resistivity experiments has been made and a correlation of the ordering kinetics with some of the physical properties of the alloy (electrical resistivity, its temperature coefficient, microhardness, paramagnetic susceptibility, and the integrated x-ray intensity of the resolved superlattice lines) is given. (INIS)

7338 HALL EFFECT IN A HOLMIUM MONOCRYSTAL. Fedorov, G. V.; Moreva, N. I.; Morozova, V. A.; Volkenshtein, N. V. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 4, 721-726(Oct 1973). (In Russian).

The field and temperature dependence of the Hall Effect in fields up to 56 kg force and at temperatures from 4.2 to 292°K was measured in holmium monocrystals in a directed magnetic field along the basic density and hexagonal axis. Comparative values are presented for the ordinary (R_0) and spontaneous (R_s) Hall coefficients, determined in the paramagnetic region, for five heavy rare earths. The principles of the patterns found for change in the absolute R_s values for this series of rare earths are discussed. (tr-auth)

7339 FIELD-ION MICROSCOPE STUDY OF DOMAIN STRUCTURE IN Ni−Mo ALLOYS. Mochalova, G. V.; Potapov, L. P. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 4, 865-869(Oct 1973). (In Russian).

Using stereograms constructed from matrix transformations, it was possible, according to field-ion images of ordered Ni-Mo alloys, to analyze the complex domain structure consisting of differently oriented domains. (tr-auth)

7340 EFFECT OF MULTIPLE α IN EQUILIBRIUM β TRANSFORMATIONS ON Zr MICROSTRUCTURE. Garber, R. I.; Kharitonova, Zh. F.; Azhazha, V. M.; V'yugov, P. N.; Velikodnaya, D. A. (Physical-Technical Inst., Kiev). Fiz. Metal. Metalloved.; 36: No. 4, 870-873(Oct 1973). (In Russian).

A single $\alpha \rightleftharpoons \beta$ transformation in Zr containing nitrogen or oxygen resulted in dislocations, and 5 such transformations increased the dislocation density in individual grains and destroyed corrosion selectivity. Slippage bands were identified only in individual grains. (tr-auth)

7341 COARSENING IN THE Sn−Cd EUTECTIC DURING UNIDIRECTIONAL SOLIDIFICATION. Jones, D. R. H. (Univ. of Cambridge, Eng.). J. Cryst. Growth; 22: No. 1, 34-36(Mar 1974).

An analysis is made of experimental data on the microstructural coarsening of the lamellar Sn−Cd eutectic behind the growth front during unidirectional solidification. Results of the work indicate that, between 423°K and the melting point, substantial coarsening probably occurs by diffusion in the interphase boundary. This result indicates that melt purity may be important in suppressing eutectic coarsening during growth. (auth)

7342 STUDY OF THE PROCESS OF RECRYSTALLIZATION IN DEFORMED, SINGLE-CRYSTAL MOLYBDENUM. Belomytsev, Yu. S.; Bulgak, L. V.; Evdokimova, D. I. pp 32-38 of Sovremennoe Sostoyanie Vysokotemperaturnoi Metallografii. Lozinskii, M. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

By the methods of ordinary and high-temperature metallography, a study was made of the effect of annealing in the temperature region of 100-1600°C on the change in structure of rolled, single-crystal molybdenum. It is shown that the most stable structure is possessed by single crystals whose plane of rolling coincides with the (001) plane in the direction of rolling [110]. These single crystals do not recrystallize on annealing up to 1600°C after having been rolled to a deformation on the order of 75%. Single crystals whose plane of rolling coincided with the (111) plane showed the greatest tendency to recrystallization. A completely recrystallized structure is formed even on annealing at 600°C for a period of 20 min. (5 figures, 9 references) (SJR)

7343 EFFECT OF NITRIDING OF THE HIGH-TEMPERATURE STRENGTH OF MOLYBDENUM AND NIOBIUM. Bobok, A. N.; Kogan, Ya. D.; Lakhtin, Yu. M. pp 138-145 of Sovremennoe Sostoyanie Vysokotemperaturnoi Metallografii. Lozinskii, M. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

A study was made of the effect of nitriding on the resistance to plastic deformation for a niobium alloy (1% Zr) and a molybdenum alloy MLT (containing about 0.08% Ti) in the interval of temperatures of 1000 to 1400°C. An analytical method was used to calculate the value of the activation energy for high-temperature breakdown which for the initial materials were 95.2 kcal/mol for the molybdenum MLT alloy and 88.7 kcal/mol for the niobium (1% Zr) alloy. Surface alloying with nitrogen increases the activation energy to 145.9 kcal/mol for molybdenum, and 151 kcal/mol for niobium. The increase in heat strength of the nitrided ma-

terials is attributed to stabilization of processes taking place in the body of the material and along the grain boundaries as a result of dispersed nitride particles. (SJR)

7344 TERNARY σ- AND x-PHASES IN THE Ta–Nb–Re SYSTEM. Savitskii, E. M.; Tylkina, M. A.; Alyushin, V. E.; Kuz'ma, Yu. B.; Telegus, V. S. Izv. Akad. Nauk SSSR, Metal.; No. 1, 229-233(1974). (In Russian).

The locations of regions for the existence of σ- and x-phases are shown on two concentration triangular plots. Between the isostructural σ- and x-phases in the binary systems Ta–Re and Nb–Re are located the regions of existence of a ternary σ-phase with a structure of the type of β-U and a ternary x-phase with a structure of the type of α-Mn. The lattice periods, temperature of initial melting, hardness, specific electrical resistance, and the superconducting transition temperature of the σ- and x-phases were determined on the Ta–Nb–Re alloys. The superconducting transition temperature of the ternary x-phase exceeds by a factor of 1.5 to 2.0 the critical temperature of binary x-phases in the systems Nb–Re and Ta–Re. Thus at a constant content of Re of about 71 at. % with an electron concentration of 6.4 elect/atom, the critical temperatures are respectively 9.8 and 8.8°K for ternary x-phases having a composition in wt %: 19.8 Ta + 5.0 Nb + 75.2 Re and 11.1 Ta + 10.9 Nb + 78 Re. (SJR)

7345 SELF-DIFFUSION OF INDIUM IN In–Sn AND In–Bi MELTS. Khar'kov, E. I.; Yakushevskii, S. Yu.; Onoprienko, G. I.; Alimova, R. F. Izv. Akad. Nauk SSSR, Metal.; No. 1, 56-59 (1974). (In Russian).

Diffusion is used as a structure-sensitive property in the above systems. The In–Sn system is characterized by the presence of a eutectic at 52 wt % In and by the absence of compounds. The self-diffusion coefficients of indium as determined by radioactive tracer did not depend on the concentration of indium, and were found to be 1.75×10^{-5} cm²/sec at 175°C and 3.00×10^{-5} cm²/sec at 300°C. On the other hand, the results for self-diffusion of indium in the In–Bi system showed a sharply expressed minimum (1.61×10^{-5} cm²/sec at 150°C, 3.00×10^{-5} cm²/sec at 300°C, and 11.33×10^{-5} cm²/sec at 600°C) at 34 wt % Bi (In_2Bi compound). The amount of the minimum decreases with increasing temperature. In a region of concentrations corresponding to compound formation in the solid phase, a sharp decrease in value of the self-diffusion coefficient D is observed at selected temperatures. (SJR)

7346 EFFECT OF bcc-METAL PURITY ON HIGH-TEMPERATURE CREEP. Abramyan, E. A.; Ivanov, L. I.; Kazilin, E. E.; Yanushkevich, V. A. Izv. Akad. Nauk SSSR, Metal.; No. 1, 150-158(1974). (In Russian).

It was found that the laws and mechanism of high-temperature (greater than $0.5T_{melt}$) creep of bcc metals (Nb and Mo) depend substantially on the metal purity. At temperatures above $0.5T_{melt}$, the creep of bcc metals contaminated with impurities (oxygen and carbon mainly) is characterized by two values of the creep activation energy: a high value numerically equal to the magnitude of the activation energy of volume self-diffusion, and a low value close to the value of activation energy of diffusion along dislocation nuclei. In the case of high-purity bcc metals at temperatures above $0.5T_{melt}$, a single value is observed for the creep activation energy, which is equal to the activation energy of volume self-diffusion. The transition temperature from low values of the activation energy to high values depends on the degree of metal purity. The more contaminated the metal, the higher the transition temperature from low values of the creep activation energy to high values. In the case of high-purity bcc metals, the mechanism controlling the rate of high-temperature creep is a nonconservative movement of edge dislocations with activation energy of the volume self-diffusion. (SJR)

7347 STRUCTURE OF BINARY EUTECTICS IN THE LIQUID STATE. Filonenko, V. A. Izv. Akad. Nauk SSSR, Metal.; No. 1, 182-188(1974). (In Russian).

Supercooling of eutectics in the Sn–Pb, Sn–Cd, Sb–Ge, Sb–Pb, and Si–Au systems was studied as a function of the magnitude and sign of the displacement energy of the components and as a function of the degree of superheating of the melt. It is shown that at E > O on a plot of the supercooling (ΔT_c) versus superheating (ΔT_h), there are two points of inflection which are the boundaries of three temperature zones. In the first (subcrystallization) zone the liquid structure is chemically inhomogeneous on a micro scale, consisting of concentration fluctuations of atoms of the A–A and B–B type. In the second zone with an increase in temperature, the quasieutectic gradually transforms into a homogeneous molecular solution. In the third zone, the structure of the liquid in near order is characterized by a chaotic distribution of atoms. The smaller E, the smaller the extent of the first and second zones. At E < O a "quasiintermetallic" coordination of atoms of the A–B type is characteristic of the liquid eutectic. On quenching, dispersed eutectics are formed from the first zone; intermediate phases (intermetallics at E < O and solid solutions or mixtures of solid solutions at E > O) are formed from the second zone. The degree of mutual solubility of the components on quenching depends on the value of the ratio of the entropies of melting of the phases S_α/S_β and on the magnitude of the displacement energy of the components in the liquid and solid states. Quenching from the third zone at a rate greater than 10^6 deg/sec leads to fixing of amorphous structures independent of the magnitude of E and S_α/S_β. (SJR)

7348 INTERACTION OF TUNGSTEN WITH BERYLLIUM. Vasina, E. A.; Panov, A. S. Izv. Akad. Nauk SSSR, Metal.; No. 1, 197-199(1974). (In Russian).

The interaction of tungsten with beryllium is accompanied by the formation of a number of compounds. The kinetics of the interaction of W with Be were studied over a wide interval of temperatures (700-1200°C). The compounds WBe_2, WBe_{12}, and WBe_{22} are formed in layers on the tungsten. The WBe_2 is attached to the tungsten layer, WBe_{22} to the beryllium metal layer, and WBe_{12} is the intermediate layer. Equations are given for the rate of growth of these phases. At 1100 to 1200°C, the rate of growth for the WBe_{22} layer is significantly greater than for WBe_2 and WBe_{12} layers. At 800 to 1200°C, the growth of WBe_{22} occurs in a single kinetic stage, while the growth of the WBe_2 and WBe_{12} beryllides occurs in two kinetic stages. The regions for the existence of each kinetic stage are determined. (SJR)

7349 DECOMPOSITION OF MARTENSITIC PHASE OF Ti–Mo ALLOYS DURING TEMPERING. Kolachev, B. A.; Mamonova, F. S.; Dyasotskaya, V. S. Izv. Akad. Nauk SSSR, Metal.; No. 1, 200-203(1974). (In Russian).

Ti–Mo alloys containing 2.1, 4.4, 5.9, and 8.3% Mo were used. After quenching from the β-region, these alloys have respectively the following phase composition: α', α'' low-alloy, α'', and α'' + β. Annealing was carried out at 450°C for various periods of time (10 min to 5 h). The 2.1% Mo alloy in the quenched state has the structure of α'-martensite. From the increase in crystal lattice periods and the appearance of dark spots of a β-phase in martensitic needles, it is possible that in the initial states of tempering at a temperature of 450°C a β-phase rich in β-stabilizers separates out of the martensite α', and the martensite α' is gradually depleted of molybdenum. This process can be represented as: $\alpha' \rightarrow (\alpha')_{depleted} + \beta \rightarrow \alpha + \beta$. The decomposition of martensite α'' in Ti–Mo alloys goes by two modes depending on the degree of alloying with molybdenum. At low concentrations of Mo the following transformation takes place: $\alpha'' \rightarrow \alpha''$ (depleted) + $\beta \rightarrow \alpha + \beta$. At high concentrations of Mo the decomposition of martensite proceeds as follows: $\alpha'' \rightarrow \beta \rightarrow \beta + \omega \rightarrow \beta + \alpha'' \rightarrow \beta + \alpha'' + \alpha \rightarrow \beta + \alpha$. The decomposition of martensite α' is accompanied by a slight strengthening of the alloy. The decomposition of martensite α'' first leads to significant strengthening of the alloy, and then to a loss in strength. The strengthening effect is determined by the alloy composition and mode of martensite decomposition. It is known that depletion of martensite α' in alloying elements leads to a decrease in hardness. This weakening is superimposed on a dispersion strengthening of martensite during its decomposition. The resulting effect of strengthening during decomposition of martensite α' in the 2.1% Mo alloy shows that in the initial stages of decomposition the factor of dispersion strengthening of the matrix dominates over softening because of Mo depletion, and with long annealing the converse is true. The greatest strengthening during annealing is observed in highly-alloyed, two-phase, Ti–Mo alloys having a α'' + β structure. (SJR)

7350 AGING OF Fe–VN AND Fe–NbN ALLOYS. Gulyaev, A. P.; Anashenko, V. N.; Karchevskaya, N. I.; Larina, O. D.; Matrosov, Yu. I. Izv. Akad. Nauk SSSR, Metal.; No. 1, 215-220 (1974). (In Russian).

Pure nitrides of vanadium and niobium in powder form were added to carbonyl steel in the preparation of vanadium and niobium steels in order to evaluate the strengthening effect of the nitrides without the conflicting effect of strengthening from the presence of carbides. The samples were subjected to a water quench after heating at 1200°C for 30 min, and also were aged at temperatures of 550 to 950°C (each 50°) with holding times of 15 min, 30 min, 1 h, 3 h, and 5 h. The strengthening effect was estimated from hardness measurements. The vanadium contents of the steel alloys were 0.05, 0.10, and 0.18 wt % V with bound nitrogen contents of 0.006, 0.018, and 0.038 wt % N respectively. The niobium contents were 0.004, 0.10, and 0.12 wt % Nb with bound nitrogen contents of 0.003, 0.007, and 0.013 wt % N respectively. In the quenched state, the hardness of the Fe–VN

and Fe–NbN alloys is higher than in pure iron. This behavior is apparently explained by the dissolution of nitrides in iron and also by the possible formation of metastable states having large internal stresses which result in alloy strengthening. On studying alloy aging at 550–850°C, by the methods of electron microscopy and phase analysis, it was established that finely dispersed particles of vanadium and niobium nitrides (from 100 to 3000 Å) precipitate out on decomposition of the solid solution. Maximum strengthening is attained at an aging temperature of 550 to 650°C. (SJR)

7351 EFFECT OF ANNEALING ON THE STRUCTURE OF V–Zr–C ALLOY. Arakelov, A. G.; Gekov, A. F.; Gorshkov, V. V.; Luk'yanov, A. N.; Polyak, L. Z.; Usikov, M. P.; Khandarov, P. A. Izv. Akad. Nauk SSSR, Metal.; No. 1, 221-223 (1974). (In Russian).

Aging of the alloy V–2.6% Zr–0.32% C at 1000°C after quenching or slow cooling from 1600 to 1700°C leads to a substantial change in morphology and structure of segregations or precipitates as determined by electron microscopy. The large equiaxial particles of ZrC remain unchanged. The large disks of V_2C also remain unchanged in form, but the lattice type changes in most particles. V_2C transforms to VC. Thin disks of V_2C dissolve, and dispersed precipitates of VC and ZrC are formed in their place. It should be noted that the increased creep resistance of the V–Zr–C alloy is apparently caused by large particles which maintain their form during prolonged aging and by newly formed dispersed particles of the stable carbides VC and ZrC which also increase the creep resistance of the alloy. (SJR)

7352 TERNARY SYSTEMS W–Zr–C AND W–Hf–C IN REGIONS RICH IN TUNGSTEN. Zakharov, A. M.; Naumkin, O. P.; Kurganov, G. V. Izv. Akad. Nauk SSSR, Metal.; No. 1, 224-228(1974). (In Russian).

By metallography and x ray phase analyses and also by the solidus temperature, a study was made of the ternary systems W–Zr–C and W–Hf–C (up to 0.5% C and 2% Zr or Hf). Plots are presented for semithermic sections of W–Hf–C and W–Zr–C and isothermal cuts at 2500, 1600, and 1100°C. The carbides W_2C, ZrC (or HfC), and a W_2Zr phase occur in these alloys in equilibrium with a tungsten solid solution. The semithermic cuts W–ZrC and W–HfC apparently are quasibinary and have phase diagrams of a eutectic type. The melting temperatures of the eutectics α + ZrC (or HfC) in these sections are equal to 2620 and 2790°C respectively. The carbides ZrC and HfC have a variable solubility in tungsten in the solid state, which decreases with decreasing temperature. The maximum solubilities of the carbides ZrC and HfC are respectively 0.4 and 1.0%, 0.3 and 0.8% at 2000°C, 0.2 and 0.5% respectively at 1600°C, and about 0.1% at 1100°C. Additions of zirconium (or hafnium) at first somewhat increase, and then decrease the solubility of carbon in tungsten in the solid state. Maximum mutual solubility of carbon and zirconium (or hafnium) in tungsten is observed near the cut W–ZrC (or HfC) at a ratio of Zr : C < 7.6 : 1 (or Hf : C < 14.9 : 1). The ternary system W–Hf–C is preferred as a base for the development of high-heat-strength tungsten alloys as compared to the W–Zr–C system. (SJR)

7353 EFFECT OF ELASTIC DEFORMATION ON THE ELECTRICAL PROPERTIES OF FINE WIRES MADE OF TUNGSTEN–RHENIUM ALLOYS. Shnyrev, G. D.; Klimov, K. M. Izv. Akad. Nauk SSSR, Metal.; No. 1, 237-238(1974). (In Russian).

During elastic deformation with elongation the electrical resistance of most metals and alloys increases. The relation between the change in electrical resistance and elastic elongation is given by the following equation: $dR/R\epsilon = 1 + 2\mu + d\rho/\rho\epsilon$. Here R is the electrical resistance of the sample; ϵ is the elastic deformation; μ is the Poisson coefficient; and ρ is the specific electrical conductivity. The deformation coefficient of the electrical resistance or the tension-sensitivity coefficient is ordinarily equal to 2-3, more rarely to 4-5. It was found to be 3.9 for a W–Re alloy with 5% Re, 5.1 to 5.4 for a W–Re alloy with 20 wt % Re, and 5.6 to 5.8 for a W–Re alloy with 27 wt % Re. The value of this coefficient is 3.0 to 4.0 for tungsten metal. It is evident that on increasing the Re content in the alloy the value of the tension-sensitivity coefficient increases from 4 to about 6. (SJR)

7354 EVIDENCE FOR A CONTINUOUS s–d TRANSITION IN FCC CESIUM AT HIGH PRESSURE. McWhan, D. B. (Bell Telephone Labs., Inc., Murray Hill, NJ); Parisot, G.; Bloch, D. J. Phys., F (London); 4: No. 4, L69-L75(Apr 1974).

Neutron diffraction measurements up to 43 kbar at 298°K show that the volume of fcc Cs is smaller than expected from a comparison with the bcc phase, with other alkali metals at high pressure, and with transition metals. This is attributed to a continuous s–d transition of the conduction electron character which causes a lowering of the average kinetic energy of the conduction electrons. (auth)

7355 EVIDENCE FOR AN ANTIPHASE TYPE OF STRUCTURE IN Pu METAL AND ITS ALLOYS. Sandenaw, T. A.; Harbur, D. R. (Los Alamos Scientific Lab., NM). J. Phys. Chem. Solids; 35: No. 7, 797-805 (Jul 1974).

The frequent irreproducibility of results from physical property measurements made on Pu metal suggests the existence of different states below room temperature. Heat capacity measurements yield evidence which can be interpreted as confirmation for an antiphase type of structure in Pu and its alloys. Other evidence from many different physical property measurements can be analyzed to give support for the presence of a long-period superlattice. Existing thermoelectric power data point out the importance of specimen cycling and holding times at temperatures below 76°K on the appearance of what can be diagnosed as low-temperature transitions. There appears to be a time-temperature dependence in the reported experimental results for many of the low-temperature physical properties of Pu. Fermi surface-Brillouin zone boundary interactions are suggested as the explanation for the low-temperature behavior of Pu metal and its alloys. They are considered to be the source of the resistivity maximum, new phases, and an antiphase type of structure. (auth)

7356 MAGNETIC STRUCTURE OF CUBIC $ErAl_3$. Will, G.; Cox, D. E. (Univ., Bonn). J. Phys. Chem. Solids; 35: No. 7, 861-863(Jul 1974).

The magnetic structure of cubic or β-$ErAl_3$ was investigated by neutron diffraction from powder samples. $ErAl_3$ undergoes a transition at 5.1°K to an antiferromagnetic state with an enlarged tetragonal unit cell. The moments are directed perpendicular to the tetragonal c-axis. Crystal field effects are large and dominant in this compound. The extrapolated saturation moment is $5.1/\mu_B$, which corresponds to the Γ_5 ground state. (auth)

7357 PREDICTING THE SURFACE TENSION OF LIQUID METALS. Sageman, D. R.; Burnet, G. (Ames Lab., Iowa). J. Inorg. Nucl. Chem.; 36: No. 5, 1105-1107(May 1974).

The recent availability of more complete and reliable surface tension data for molten metals has led the authors to seek a general surface tension correlation which would include other fundamental properties of the molten metals. The relationship proposed has a thermodynamic basis and relates the surface tension of a molten metal to its heat of vaporization and ionic radius. Based on data reported by several investigators, the error in the calculated value of surface tension is less than 10% in the melting point region. (auth)

7358 NUCLEAR SPIN LATTICE RELAXATION AND TRANSLATIONAL DIFFUSION IN BERYLLIUM. Chabre, Y. (CNRS, Grenoble, France). J. Phys., F (London); 4: No. 4, 626-638(Apr 1974).

Measurements are presented of NMR spin lattice relaxation time in beryllium metal between 300 and 1200°K. A very low electronic contribution to the relaxation (T_{1e} $T = 1.85 \times 10^4$sK) makes it possible to observe the dipolar contribution due to Be atomic motions as well as the quadrupolar contribution due to field gradient fluctuations coming from vacancy and impurity motions. From the slope of the dipolar contribution, a value of 1.35 eV can be deduced for the self-diffusion activation energy, in agreement with previous values obtained by T_2 measurements. The quadrupolar contribution attributed to vacancy motions presents a maximum at about 570°K. This gives a value of 0.65 eV for the migration energy. The slope of this contribution is strongly dependent on the thermal treatment and the purity of the samples. This can be understood if account is taken of bounded vacancies with binding energy as high as −0.5 eV. (auth)

7359 MAGNETIZATION AND MICROWAVE RESONANCE IN Gd–Y ALLOYS. Bagguley, D. M. S.; Liesegang, J.; Robinson, K. (Oxford Univ.). J. Phys., F (London); 4: No. 4, 594-625 (Apr 1974).

Measurements of magnetization and microwave resonance were carried out on six single-crystal Gd–Y alloys, having compositions 6, 28, 53, 58, 59, and 64 at. % Gd. From measurements at 4 to 290°K, values of the exchange parameters J(Q), J(O), J_6 are estimated. A microwave resonance in the low-temperature antiferromagnetic spiral phase was observed for the 6 and 28 at. % Gd alloys. Anisotropy constants are derived from the microwave measurements in the ferromagnetic phases. The order of magnitude of K_6 at 0°K is 3×10^6 erg cm^{-3}, and the hard axis of magnetization is the [0001] –c crystal axis. (auth)

7360 NMR STUDY AND MAGNETIC PROPERTIES OF VANADIUM BASED ALLOYS WITH TRANSITION METALS. Panissod, P. (Univ., Strasbourg). J. Phys., F (London); 4: No. 3, 484-496(Mar 1974).

New relaxation time measurements in dilute V–T alloys (T = Co, Mo, Rh, Ta, W, Re, Os, Ir) and concentrated σVCo,

VCo_3, VRh_3, and VIr_3 alloys are presented. From these experimental results and previous bulk susceptibility and Knight shift measurements by Devos in 1972, the various contributions to the bulk susceptibility of these alloys and particularly the Pauli and Van Vleck vanadium susceptibilities are calculated. This allows a systematic study of the magnetic behavior of vanadium alloys with transition metals as a function of the nature and the concentration of the impurity. New NMR results (Knight shifts, line widths and relaxation rates) in concentrated $V_{1-c}Ni_c$ alloys ($85\% \leq c \leq 87\%$) are also presented in order to study the magnetic behavior of vanadium up to the critical concentration for the occurrence of ferromagnetism ($c_{cr} \sim 87.5\%$). The vanadium susceptibility is shown always to decrease with increasing impurity concentration and to have very low values for high impurity concentration, even in nearly ferromagnetic alloys (VCo_3 and concentrated VNi alloys). (auth)

7361 DE HAAS-VAN ALPHEN EFFECT IN YTTRIUM. Young, R. C.; Jordan, R. G.; Jones, D. W.; Hems, V. J. (Univ. of Birmingham, Eng.). J. Phys., F (London); 4: No. 4, L84-L86 (Apr 1974).

The de Haas–van Alphen effect was observed in a single crystal of yttrium (resistance ratio 120) which was refined by solid-state electrotransport processing. At the c axis, two frequencies (3.27×10^6 G and 3.9×10^6 G) are found. The first, for which the cyclotron mass was found to be 0.39 ± 0.01 mo, is interpreted as the orbit δ of Loucks' APW model. The second can also be explained on this model by the introduction of spin–orbit coupling. (auth)

7362 MODULATION METHOD FOR MEASURING SPECIFIC HEAT. Kraftmakher, Ya. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). High Temp.–High Pressures; 5: No. 4, 433-454(1973).

The modulation method for measuring specific heat is reviewed. Various ways of modulating the heating power and of registering the temperature oscillations of the sample are discussed. Experimental setups are described and some data for samples including tantalum, molybdenum, niobium, and lanthanum obtained by the modulation method are presented. (auth)

7363 NEUTRON CRYSTAL-FIELD SPECTROSCOPY AND SUSCEPTIBILITY IN $Er_c Y_{1-c} Al_2$. Heer, H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland); Furrer, A.; Walker, E.; Treyvaud, A.; Purwins, H. G.; Kjems, J. J. Phys., C (London); 7: No. 6, 1207-1213(21 Mar 1974).

Inelastic neutron scattering experiments and susceptibility measurements were carried out on polycrystalline $Er_cY_{1-c}Al_2$. A least-squares fitting procedure was applied to the neutron data which favours four sets of crystal-field parameters. Results are compared with the measured susceptibility and other bulk magnetic properties. It is concluded that the crystal-field parameters $x = -0.54$ and $W = -0.018$ meV are the most probable ones. (auth)

7364 SHORT RANGE ORDER AND THE DEVELOPMENT OF LONG RANGE ORDER IN Ni_4Mo. Chakravarti, B. (Georgia Inst. of Tech., Atlanta); Starke, E. A. Jr.; Sparks, C. J.; Williams, R. O. (1973). vp.

From international symposium on order–disorder transformation in alloys; Tuebingen, Ger. (3 Sep 1973).

The short-range ordered structure present in quenched Ni_4Mo and the initial development of the long-range-ordered structure have been studied using single crystal x-ray diffuse scattering techniques. Measurements of the diffuse x-ray intensities were made in a volume in reciprocal space for the fcc alloy resulting in a quantitative determination of the three dimensional local-order parameters. The local-order parameters were used for a computer simulation of the atomic configuration. (INIS)

7365 TRANSMISSION ELECTRON MICROSCOPY INVESTIGATIONS OF ORDERED Zr_3Al. Howe, L. M.; Rainville, M.; Schulson, E. M. (Atomic Energy of Canada Ltd., Chalk River). J. Nucl. Mater.; 50: No. 2, 139-154(Mar 1974).

Zr_3Al is an ordered fcc alloy of the $L1_2$ type. The ordered phase appears to be very stable thermally as it has not been possible to disorder Zr_3Al by quenching. It is possible, however, to disorder Zr_3Al by irradiation. In deformed Zr_3Al the superlattice dislocations were observed to be extended, i.e., they consisted of intrinsic stacking faults on {111} bounded by partial dislocations. The total Burgers vector is of the type ⟨110⟩ and the superlattice dislocations have dissociated as follows: $\langle 110\rangle \rightarrow \frac{1}{3}\langle 211\rangle + \frac{1}{3}\langle 12\bar{1}\rangle$. During high-temperature annealing of the deformed material, dislocation networks were produced in which all of the dislocation nodes were extended; hence intrinsic and extrinsic stacking faults must alternate at the nodes. Weak beam images were obtained of long and relatively straight dislocation lines in annealed Zr_3Al in order to obtain information on the equilibrium width of the extended dislocations. (auth)

7366 ELECTROPHYSICAL PROPERTIES OF FILMS OF VANADIUM AND TANTALUM PRODUCED AND ANNEALED IN VERY HIGH VACUUM. Osipov, K. A.; Orlov, A. F.; Ivanovskaya, G. F. Izv. Akad. Nauk SSSR, Metal.; No. 1, 178-181(1974). (In Russian).

By electron-beam evaporation and condensation in a very high vacuum, it was possible to obtain reproducibly superconducting films of V and Ta having transition temperatures to the superconducting state corresponding to those of the pure massive materials, and having a small transition width (at a film thickness of less than 2000 Å). For V, the optimum condition for depositing the film on a polished sapphire backing was a condensation rate of 50 to 150 Å sec in a vacuum of 7×10^{-8} torr with an annealing temperature of 500 to 600°C. For Ta, the optimum film conditions involved a deposition rate of 3 to 6 Å/sec at a vacuum of $< 3 \times 10^{-8}$ torr and film annealing in vacuum at 300 to 400°C. The thin films were covered with a layer of silicon monoxide before exposure to the atmosphere. (SJR)

7367 NUCLEAR MAGNETIC RESONANCE (KNIGHT SHIFT) AND MAGNETIC SUSCEPTIBILITIES OF V–Ta–Nb ALLOYS. Kalantaryan, V. P.; Chechernikov, V. I. (Moscow State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 3, 197-204(1973). (In Russian).

The results of nuclear magnetic resonance (Knight shift) measurements on ^{51}V and ^{93}Nb nuclei and magnetic susceptibilities in V–Ta–Nb alloy system are given. The estimates of contact, exchange polarization and orbital contributions to the Knight shift are given and the orbital shift is shown to be predominant due to the orbital motion of d-electrons. (auth)

7368 NEUTRON DIFFRACTION DETERMINATION OF THE NUMBER AND DISPLACEMENT OF THE ATOMS IN THE DIFFUSE OMEGA PHASE OF $Zr_{0.8}Nb_{0.2}$. Keating, D. T.; LaPlaca, S. J. (Brookhaven National Lab., Upton, NY). J. Phys. Chem. Solids; 35: No. 7, 879-891(Jul 1974).

Alloys of Zr and Nb with Nb concentrations between 5 and 17% undergo an athermal displacive transformation from bcc to the hexagonal ω-phase. The ω start temperature depends on Nb concentration. The ω structure is derived from bcc by the displacement of atom rows parallel to [111]. For Nb concentrations greater than 17%, the Bragg reflections characteristic of the ω-phase never develop under athermal conditions but a diffuse scattering in their vicinity is present. The alloy in this state is referred to as diffuse omega phase and omega domains cannot be imaged in the electron microscope. Coherence of the displaced atoms with the bcc lattice allows the determination of the number of displaced atoms and their mean displacement from intensity measurements of the bcc Bragg reflections. At 300°K, some 32% of the atoms in the $Zr_{0.8}Nb_{0.2}$ alloy are displaced 56.2% of the way to the ideal ω positions as represented by the AlB_2 structure. Both the number of atoms and their mean displacement increase as the temperature is lowered. It is believed these results are the first to quantify the diffuse omega phase. (auth)

7369 RECOVERY BEHAVIOR OF COLD-WORKED AND QUENCHED ZIRCALOY WITH VARYING OXYGEN CONTENT. Sauby, M. E.; Lee, D. (General Electric Research and Development Center, Schenectady, NY). J. Nucl. Mater.; 50: No. 2, 175-182(Mar 1974).

The recovery behavior of cold-worked and quenched Zircaloy-2 was examined in terms of variations in oxygen content, from about 140 to 1700 ppM O. The cold work was produced by swaging to a 50% reduction in area at room temperature and the quenching was done into ice-brine from a temperature of 800°C. Isochronal recovery started at lower temperatures for the lowest oxygen alloys, but the rates of recovery were greater for the high-oxygen alloys. In addition, the high-oxygen alloys appeared to undergo hardening during the isochronal annealing, reaching a peak in the temperature region of 475 to 525°C. Net strengthening achieved by quenching was greater than the 50% cold work. This was attributed to the dual effect of solute supersaturation and formation of quenched-in defect clusters. Hardness change, however, occurred in three distinct stages. The change in oxygen content appeared to have a less significant effect on the recovery of quenched-in damage than on the recovery of cold-work damage. (auth)

7370 TRANSITION FROM DISLOCATION CLIMB TO VISCOUS GLIDE IN CREEP OF SOLID SOLUTION ALLOYS. Mohamed, F. A.; Langdon, T. G. (Univ. of Southern California, Los Angeles). Acta Met.; 22: No. 6, 779-788(Jun 1974).

There are two distinct and separate classes of creep behavior in metallic solid solution alloys. The mechanism of creep in

Class I alloys appears to be some form of dislocation climb process, whereas the mechanism in Class II alloys appears to be a viscous glide process. By making assumptions concerning the nature of the climb and glide processes, and using existing experimental results for an Al–3% Mg alloy, it is shown that, to a first approximation, the criterion for deformation by viscous glide is given by

$$\frac{B\sigma^2}{k^2(1-\nu)}\left(\frac{\gamma}{Gb}\right)^3 > \frac{T^2}{e^2cb^2}$$

where $B \sim 8 \times 10^{12}$, σ is the applied stress, k is Boltzmann's constant, ν is Poisson's ratio, γ is the stacking fault energy, G is the shear modulus, b is the Burgers vector, T is the absolute temperature, e is the solute–solvent size difference, and c is the concentration of solute atoms. The creep behavior of twenty-eight different solid solution alloys is analyzed, and it is shown that all alloys except one (Au–10% Ni) give results which are consistent with this criterion for viscous glide. (auth)

7371 DEVELOPMENT OF A THEORETICAL EQUATION FOR STEADY-STATE DISLOCATION CREEP AND COMPARISON WITH DATA. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields, Eng.). Acta Met.; 22: No. 6, 789-791(Jun 1974).

For nineteen materials, including silver, tantalum, and gamma iron, Ashby found that an empirical equation $\dot{\epsilon}_s = A(D_v\mu b/kT)(\sigma/\mu)^n$ gives a reasonable fit to steady-state creep data where A and n are materials constants. It is now shown that if the materials obey the Bailey–Orowan equation, Taylor's work-hardening model, and Friedel's network-climb recovery-equation, then an identical creep equation is predicted with $A = 8\pi^2 c_j$ and $n = 3$. Here c_j = jog-concentration. In the cases of nickel, cadmium, beta thallium, and stoichiometric UO_2 the predicted and actual creep strengths differ by less than a factor of two. (auth)

7372 PREDICTION OF THE COMPOSITION OF F.C.C. INTERSTITIAL PHASES WHEN PRECIPITATED IN STEEL. Roberts, W.; Grieveson, P. (Univ. of Strathclyde, Glasgow). Scr. Met.; 8: No. 5, 451-458(May 1974).

The composition of the nitride or carbide phase in steels can be predicted from thermodynamic data. This method is illustrated using NbC_x and TiC_x in steels. Free energy–composition diagrams are given for the Nb–C and Ti–C systems at 1000°C; they predict that for steels containing 0.2% C and 0.5% Nb or Ti and aged at 1000°C, the precipitates will eventually attain a composition of $NbC_{0.89}$ and $TiC_{0.75}$. (DLC)

7373 COMMENTS ON "A MECHANISM OF THE UNEXPECTED [110] SLIP OBSERVED IN B.C.C. METALS DEFORMED AT LOW TEMPERATURES". Taylor, G. (Oxford Univ.). Scr. Met.; 8: No. 5, 459-462(May 1974).

Difficulties are pointed out in Matsui–Kimura's "surface-effect" mechanism (Scr. Met. 7: 905(1973)), in which part of a screw dislocation emerging at the top face is deflected by the image force into the (110) plane most nearly perpendicular to the local crystal surface. It is stated that anomalous slip does not really occur in Mo and W; considerable primary slip also occurs. Anomalous slip is observed only in purified material, and it is unlikely that the screw dislocation core is intrinsically responsible for anomalous slip. (DLC)

7374 REPLY TO COMMENTS ON "A MECHANISM OF THE UNEXPECTED [110] SLIP OBSERVED IN B.C.C. METALS DEFORMED AT LOW TEMPERATURES". Matsui, H.; Kimura, H. (Tohoku Univ., Sendai). Scr. Met.; 8: No. 5, 463-466(May 1974).

The surface-effect mechanism (Scr. Met. 7: 905(1973)) does not assume the slip dislocations all have the primary Burgers vector. The orientation dependence and application to round section specimens are discussed. Slip occurs in two directions in the anomalous slip plane in Mo, Nb, and V. Anomalous slips observed in Mo and W are of the same character as in Va metals; it is considered unimportant whether the anomalous slip is the major slip or not. (DLC)

7375 DIRECT OBSERVATION OF ACTIVE "UNEXPECTED SLIP" IN MOLYBDENUM BY HVEM. Matsui, H. (Tohoku Univ., Sendai); Saka, H.; Noda, K.; Kimura, H.; Imura, T. Scr. Met.; 8: No. 5, 467-474(May 1974).

An unexpected slip was observed to operate actively in Mo at both room and low (–120°C) temperatures during tensile testing. The appearance of $(\bar{2}13)$ [111] slip instead of $(\bar{1}01)$ [111] and (101) $[1\bar{1}1]$ can be understood using the "surface-effect" mechanism. $(\bar{1}01)$ slip is presented as one of the most favored systems with the model (Scr. Met. 7: 905(1973)). (DLC)

7376 DYNAMIC EFFECTIVE-FIELD SCHEME FOR RARE-EARTH SYSTEMS. Furrer, A.; Heer, H. (Eidgenoessische Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Phys. Rev. Lett.; 31: No. 22, 1350-1353(26 Nov 1973).

The importance of including the dynamical exchange-interaction term in the Hamiltonian of a rare earth system is demonstrated. The probability distribution of the dynamic exchange field is derived in the molecular field approximation. The result is exemplified for the zero-field magnetization and crystal field spectroscopy of NdSb. (auth)

7377 LOW-TEMPERATURE RELAXATION PROCESSES IN COLD-WORKED ZIRCONIUM. Savino, E. J.; Bisogni, E. A. (Comision Nacional de Energia Atomica, Buenos Aires). J. Nucl. Mater.; 50: No. 3, 298-308(Apr 1974).

The internal friction and modulus relaxation spectrum of high-purity polycrystalline zirconium has been studied between 77°K and room temperature. Low (1 Hz) and high (50 kHz) frequency measurements are reported after room- and low-temperature tensile deformation. Three relaxation peaks appeared, called P_1, P_2, and P_3. The variation of these with the measuring frequency, amount of cold work, and annealing of the specimen at temperatures above that of deformation was investigated. The peak P_1 appeared in the range 80 to 90°K at 1 Hz after cold work at 80°K and disappeared on heating the specimen above 200°K. P_2 appeared either after deformation at room temperature or at low temperature if followed by an annealing process above 200°K; this peak is a very wide one at low frequencies (1 Hz) with its maximum at about 150°K. P_3, generated by cold-working the specimen at 80°K, proved to be very unstable and recovered while being measured at 1 Hz; its physical origin is still uncertain. The recovery of the modulus defect after deformation at 80°K showed three stages, coincident with those of resistivity reported in the literature. The peak P_1 is considered to be due to the relaxation of dislocations against intrinsic lattice barriers, the peak P_2 to the interaction of point defects with dislocations. (auth)

7378 KHIMIYA METALLICHESKIKH SPLAVOV. (Chemistry of Metal Alloys). Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). 239p.

Experimental and theoretical investigations are given of phase studies, thermodynamic properties, chemical properties, and crystal structure of metals and alloys. Four chapters are included in Nuclear Science Abstracts. (SFL)

For abstracts of individual chapters see: 7379–7381, and 7430.

7379 EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE THERMODYNAMIC PROPERTIES AND COMPUTER CALCULATION OF THE DECAY OF THE PHASE DIAGRAM OF THE γ-URANIUM–MOLYBDENUM SYSTEM. Ivanov, O. S.; Udovskii, A. L.; Vamberskii, Yu. V. pp 21-31 of Khimiya Metallicheskikh Splavov. Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The thermodynamic properties of the U–Mo system is investigated by the emf method with liquid electrodes in the temperature interval from 1048 to 1173°K. The excess thermodynamic functions of entropy, enthalpy, and free energy as a function of concentration are characterized by sign change. A theoretical study is made of the physical result in the complex character of the change of the excess thermodynamic functions. A result of this study was the possibility in principle of the computer calculation of the decay curves of the phase diagram. The calculation was made on the "Minsk-22M" computer in the temperature interval from 900 to 1400°K. The decay curves calculated agree well with the experimental phase diagrams. (tr-auth)

7380 INTERACTION OF RUTHENIUM WITH THE TRANSITION ELEMENTS OF THE IV AND V GROUPS. Sokolovskaya, E. M.; Raevskaya, M. V.; Tetarkina, A. L.; Gulamova, D. D.; Akhverdyan, M. M. pp 80-85 of Khimiya Metallicheskikh Splavov. Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The interaction of Ru with the transition metals of the IV and V groups Ti, Zr, Hf, Nb, and V is examined. In the study of the phase diagram of Ru–Nb by the diffusion layer method using local x-ray spectral analysis, the existence of only one two-phase region $\alpha + \rho$ is detected. For the ternary systems Nb–Ru–Ti, Nb–Ru–Zr, and Nb–Ru–Hf at 1600 to 1050°, the continuous mutual solubility of the stable phases $RuMe^{IV}$ (CsCl type) and NbRu phases (tetragonal distorted variant of the CsCl type structure) was established. The intertransition structure in the regions studied is connected with the change of the mean electron concentration in the alloys. Phase diagrams are also found for the ternary systems Ru–Ti–Zr, Ru–Ti–Hf, and Ru–Zr–Hf. In the phase diagram of the Ru–V–Zr system, a new intermediate phase $ZrRu_{0.7-0.5}V_{1.3-1.5}$ was found related to the $MgZn_2$-type structure and with the parameters a = 5.26 to 5.30 Å, c = 8.40 to 8.58 Å, and c/a = 1.62. (5 fig) (tr-auth)

7381 RECRYSTALLIZATION BY PROCESS ANNEALING OF METALLIC COMPOUNDS AND THE PROPERTIES OF ALLOYS IN THE Al–Cu–Y SYSTEM. Drits, M.E.; Kadaner, E. S.; Nguen Din Shoa. pp 167-170 of Khimiya Metallicheskikh Splavov. Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The recrystallization of the metallic compounds YAl_3, YCu_4Al_8 (ψ), and $YCu_{0.5}Al_{3.5}$ (D), present in the Al-rich side of the Al–Cu–Y system, was studied by measurement of the microhardness in the temperature range up to 250°C. The ψ phase has a very high value for the microhardness and is weakly recrystallized during heating. The D phase has a high microhardness at room temperature but is strongly recrystallized with temperature and time. The YAl_3 phase is characterized by lower microhardness than in the ternary phase; it is recrystallized at 150° but with extended increase of temperature the microhardness of this phase is changed little. A definite correlation was established between the properties of the phase studied and the properties of the alloys in which they are found. (tr-auth)

7382 CONTROL OF GRAIN SIZE IN URANIUM–CHROMIUM ALLOYS BY HEAT TREATMENT. Roman, I. (Hebrew Univ., Jerusalem); Oron, M.; Rosen, M. J. Nucl. Mater.; 50: No. 3, 309-310(Apr 1974).

A double-stage heat-treatment procedure used in producing fine equi-axed grain structure in U–Mo, and U–Cr fuel alloys is described. This structure is desirable in fuel elements to reduce surface roughening and cracking during operational thermal cycling. (JRD)

7383 MAGNETIC PROPERTIES OF $NpPd_3$ AND $PuPd_3$ INTERMETALLIC COMPOUNDS. Nellis, W.J.; Harvey, A.R.; Lander, G.H.; Dunlap, B.D.; Brodsky, M.B.; Mueller, M.H.; Reddy, J.F.; Davidson, G.R. (Argonne National, Laboratory, Argonne, Illinois 60439). Phys. Rev. B 9: No. 3, 1041-1051 (1 Feb 1974).

Magnetization, electrical-resistivity, Mössbauer-effect, and neutron-diffraction measurements have been made between 1.5 and 300 °K for two phases of $NpPd_3$ and for $PuPd_3$. The compounds $PuPd_3$ and cubic $NpPd_3$ have the $AuCu_3$-type crystal structure. Hexagonal $NpPd_3$ has the $TiNi_3$-type structure and is the room-temperature equilibrium phase. Cubic $NpPd_3$ can be retained by rapid quenching, and the specimen used in this investigation has a long-range order parameter of S = 0.92. The cubic $NpPd_3$ compound is antiferromagnetic with a Néel temperature $T_N = (55\pm1)$ °K, and the magnetic transition is apparently first order, since the sublattice magnetization is constant up to 45 °K. A large energy gap Δ in the spin-wave dispersion relation is observed below 40 °K in the electrical resistivity with $\Delta \simeq 3kT_N \simeq k\Theta \simeq k(150$ °K), where Θ is the Debye temperature obtained from the resistivity data. Cubic $PuPd_3$ is antiferromagnetic below 24 °K. Cubic $NpPd_3$ and $PuPd_3$ have a magnetic structure that consists of ferromagnetic (111) planes coupled antiferromagnetically, and they have ordered moments of (2.0 ± 0.1) μ_B/Np atom and (0.8 ± 0.1) μ_B/Pu atom, respectively. Hexagonal $NpPd_3$ does not possess long-range magnetic order, but does appear to have an abrupt transition to short-range magnetic order distributed throughout the bulk below ~32 °K, as indicated by an apparent Curie temperature in the magnetization, a spin-disorder resistivity anomaly, and a broadening of the paramagnetic Mössbauer line as the temperature is lowered from 30 to 4.2 °K. Both $NpPd_3$ phases have the same effective paramagnetic moment of 2.74 μ_B/Np atom, consistent with the Np^{3+} ionic configuration, the same volume per formula unit, and essentially the same first-and second-nearest-neighbor neptunium environment. The difference in magnetic behavior between the cubic and hexagonal phases of $NpPd_3$ is at present not understood. (auth)

7384 PRECISION MEASUREMENTS OF THE THERMAL CONDUCTIVITY, ELECTRICAL RESISTIVITY, AND SEEBECK COEFFICIENT FROM 80 TO 400 K AND THEIR APPLICATION TO PURE MOLYBDENUM. Moore, J.P.; Williams, R.K.; Graves, R.S. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Rev. Sci. Instrum. 45: No. 1, 87-95 (Jan 1974).

A longitudinal heat-flow technique for precise measurement of thermal conductivity, electrical resistivity, and Seebeck coefficient over the temperature range from 80 to 400 K is described. The basis of the technique is the use of a calibrated platinum resistance thermometer to provide in situ calibrations of specimen thermocouples. The total determinate errors at 273 K are $\pm$0.23% for electrical resistivity, 0.49% for thermal conductivity, and $\pm$0.07 μV/K for the Seebeck coefficient when Pt wire is used as the reference. Experimental results on two high-purity molybdenum specimens with cross-sectional areas differing by a factor of four are presented to demonstrate the system precision and low level of indeterminate errors. (auth)

7385 TRANSPORT PROPERTIES OF β LANTHANUM. Zinov'ev, V.E.; Gel'd, L.P.; Morozova, V.A.; Chuprikov, G.E. (S. M. Kirov Ural Polytechnic Institute, Sverdlovsk). Sov. Phys.–Solid State 15: No. 7, 1499-1500 (Jan 1974).

The total thermal conductivity of lanthanum at high temperatures has been evaluated from measurements of the thermal diffusivity (595 to 1150°K) and the temperature dependence of the electrical resistivity (between 293 and 910°K).(AIP)

7386 ELECTRICAL RESISTANCE OF PURE GADOLINIUM AND ITS ALLOYS WITH IRON NEAR THE CURIE POINT. Nabutovskaya, O.A. (Institute of Inorganic Chemistry, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.–Solid State 15: No. 7, 1450-1451 (Jan 1974).

The temperature dependence of the electrical resistance and the microstructure of pure gadolinium and its dilute alloys with iron (1 percent and 1.86 percent iron) have been investigated. (AIP)

7387 DETERMINATION OF THE DENSITY OF PHONON STATES FOR COHERENTLY SCATTERING CRYSTALS. Eremeev, I.P.; Sadikov, I.P.; Chernyshov, A.A. Sov. Phys.–Solid State 15: No. 7, 1309-1314 (Jan. 1974).

A method for determining the density of phonon states $g(\omega)$ based on averaging the interference effects in the cross section for inelastic coherent neutron scattering by a polycrystalline sample is used to study the dynamics of the hexagonal metals in group II Mg, Zn, and Cd. The physical prerequisites of the method are considered and an expression is given for the scattering cross section, taking account of the inelastic structure factor of the polycrystalline sample. The limits of applicability and the inherent errors of the method are discussed. The experimental method and the procedure for obtaining the function $g(\omega)$ from the measured cross section for inelastic coherent scattering are described. Magnesium is used as an example for estimating the precision in the determination of $g(\omega)$ as a function of the experimental conditions. The data obtained are compared with the results of calculations of $g(\omega)$ in Mg within the framework of the Born–von Karman theory (using models with various sets of force constants). It is shown that the method used allows us to measure $g(\omega)$ with acceptable precision not only for coherently scattering Bravais crystals with cubic symmetry but also for more complex structures with atoms of a single kind in the unit cell. The properties determined most reliably are the behavior of $g(\omega)$ in the low-frequency region, the boundary of the spectrum, and the positions of the main singularities. (auth)

7388 CRYSTAL FIELD IN AMORPHOUS RARE-EARTH–IRON ALLOYS. Sarkar, D., Segnan, R.; Cornell, E.K.; Callen, E. (Physics Department, American University, Washington, D. C. 20016); Harris, R.; Plischke, M.; Zuckerman, M.J. Phys. Rev. Lett. 32: No. 10, 542-544 (11 Mar 1974).

Iron–57 Mössbauer absorption measurements and computer calculations show the crystalline electric field to be sharply defined in amorphous metals and alloys. Above the Curie point of amorphous rare-earth–iron compounds we observe a well-defined quadrupole splitting, but in the ferromagnetic phase there is no spectroscopic structure. Computer calculations based on a recent model of the magnetism of rare-earth–transition–metal compounds yield both the paramagnetic doublet and the ferromagnetic flat spectrum. (auth)

7389 INDUCED POLARIZATION OF ADSORBED MOLECULES IN AN INTENSIVE LIGHT FIELD. Artamonov, O.M.; Asalkhanov, Y.I. Opt. Spectrosc. (USSR) 35: No. 5, 518-519 (Nov 1973).

The experimentally observed changes of optic characteristics of a layer of acetone, alcohol, and carbon monoxide molecules adsorbed at a molybdenum surface on illumination with a plane-polarized light beam of a gas laser is described. A brief description of experimental procedure and results is given. It is pointed out that this effect must be considered in ellipsometric measurements. (auth)

7390 OPTICAL REFLECTANCE SPECTROSCOPY OF SURFACE STATES IN H_2 CHEMISORPTION ON W(100). Rubloff, G.W.; Anderson, J.; Passler, M.A.; Stiles, P.J. (Brown University, Providence, Rhode Island 02912). Phys. Rev. Lett. 32: No. 12, 667-670 (25 Mar 1974).

Surface reflectance spectroscopy is used to determine optical transitions associated with the electronic structure of a W(100) surface during H_2 chemisorption. Correlation with photoemission and field-emission data attributes these transitions to excitations from intrinsic and adsorbate-induced levels to final states at the Fermi energy. (auth)

7391 SHORT-RANGE AND LONG-RANGE ORDER IN THE ARRANGEMENT OF THE INTERSTITIAL ATOMS IN (34%Ta66%Ti)D_x. Miron, N.F.; Shcherbak, V.I.; Bykov, V.N.; Levdik, V.A. Sov. Phys.–Crystallogr. 18: No. 4, 532-533 (Jan 1974).

The nature of the distribution of interstitial deuterium atoms in solid solutions of (34% Ta–66%Ti)D_x, where x=0.35 and 0.70, has been investigated by neutron diffraction. (AIP)

7392 PROPAGATION OF DOPPLERONS IN CADMIUM IN AN INCLINED MAGNETIC FIELD. Lavrova, V.V.; Skobov, V.G.; Fisher, L.M.; Chernov, A.S.; Yudin, V.A. (A. F. Ioffe Physicotechnical

Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Solid State 15: No. 8, 1558-1562 (Feb 1974).

A theoretical and experimental investigation was made of electromagnetic waves (dopplerons) traveling in cadmium in an inclined magnetic field. A study was made of the dependence of the surface-resistance oscillations of a plate on the mutual orientations of the magnetic field $\vec{H}$, the hexagonal axis C_6, and the normal to the surface $\vec{n}$. The magnetic Landau damping was was found to depend strongly on the angle between $\vec{H}$ and C_6. For the same value of the angle Φ between $\vec{H}$ and $\vec{n}$ the Landau damping is weak in the $\vec{H} \| C_6$ case and strong in the case when $\vec{H}$ is inclined relative to C_6. In the first case a doppleron exists in a wide range of values of Φ and in the second case in a narrow range. It is found that for $\vec{n} \| C_6$ the doppleron spectrum is bounded by an upper field limit, whose magnitude decrease rapidly with Φ. The appearance of this limit results in the destruction of the doppleron oscillations is strong fields. The experimental and theoretical results are in qualitative agreement. (auth)

7393 STANDING MAGNETOELASTIC WAVES IN RARE-EARTH FERROMAGNETIC FILMS. Elliott, M.T.; O'Donnell, M.; Blackstead, H.A. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. Lett. 32: No. 13, 734-737 (1 Apr 1974).

Diagonalization of a Hamiltonian containing magnetic, elastic, and magnetoelastic contributions leads to mixed modes of magnetoelastic character. Linear combinations of creation operators appropriate to standing waves are formed, and boundary conditions require a node at the substrate-film interface, and an antinode at the free surface. Standing-wave modes can be excited with applied rf and dc fields perpendicular to each other in the plane of the film. (auth)

7394 ULTRASONIC EQUATION OF STATE OF RHENIUM. Manghnani, M.H.; Katahara, K. (Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hawaii 96822); Fisher, E.S. Phys. Rev. B 9: No. 4, 1421-1431 (15 Feb 1974).

The elastic constants C_{ij} of single-crystal Re and their pressure derivatives dC_{ij}/dP, measured to 4.2 kbar at 25 °C, are, repectively: C_{11}: 61773.3 and 8.65; C_{33}: 6828.2 and 8.45; C_{13}: 2055.7 and 2.98; C_{44}: 1605.4 and 1.49; C_{66}: 1714.1 and 1.56. The initial pressure derivative of the isothermal bulk modulus, $K_T' = (\partial K_T/\partial P)_{P_{SF}=0}$, calculated from the Voigt–Reuss–Hill approximation, is 5.43, which is significantly larger than the previously reported value of 2.93 based on x-ray–diffraction data. The contributions to K_T and K_T' from long-range Fermi energy and short-range ion-core repulsive interactions (K_F and K_{SR}, respectively) are evaluated by assuming the Born–Mayer potentials for the latter contribution. Using an empirical relationship between atomic volume and K_T' ($\simeq K_s'$), it is found that the x-ray value for K_T' is probably too low. Evaluation of the Born–Mayer parameters leads to the conclusion that the short-range contribution, rather than the Fermi contribution, dominates K_T, and shear moduli C_{44} and C_{66}, and their pressure derivatives, whereas the Fermi energy is a major contributory factor in the case of shear modulus $C_H = (1/6)(C_{11} + C_{12} + 2C_{33} - 4C_{13})$. The latter conclusion is strengthened by the nonlinearity of C_H with respect to pressure, and by the anomalous variation of the superconducting temperature T_c with pressure, which effect is related to the change in Fermi-surface topology. The value of the Grüneisen-mode gamma γ_H for Re, calculated from the dC_{ij}/dP, is 1.83, which is significantly less than thermal gamma γ_{th} (2.39) at 300 °K. (auth)

7395 ELASTIC CONSTANTS OF NIOBIUM-RICH ZIRCONIUM ALLOYS BETWEEN 4.2 K AND ROOM TEMPERATURE. Hayes, D.J.; Brotzen, F.R. (Rice University, Houston, Texas 77001). J. Appl. Phys. 45: No. 4, 1721-1725 (Apr 1974).

The adiabatic elastic constants were determined for niobium and for its alloys containing 1.4, 3.6, and 6.0 at.% zirconium. The c_{11}, c_{12}, and c_{44} constants as well as the shear constant $C' = (1/2)(c_{11} - c_{12})$ and the bulk modulus were tabulated between 4.2 and 290 K. The unusual temperature dependence of the shear constant c_{44} found in niobium was also observed in the alloys. The Debye temperatures were computed from the constants at 4.2 K. (auth)

7396 RESISTIVITY OF NEARLY MAGNETIC METALS AT HIGH TEMPERATURES: APPLICATION TO NEPTUNIUM AND PLUTONIUM. Jullien, R.; Béal-Monod, M.T.; Coqblin, B. (Laboratoire de Physique des Solides, Université Paris-Sud, 91405 Orsay, France). Phys. Rev. B 9: No. 4, 1441-1457 (15 Feb 1974).

It is shown that, in nearly magnetic metals, taking into account the temperature dependence of the Stoner susceptibility makes the electron–paramagnon electrical resistivity depart from the usual low-temperature T^2 and T power laws at temperatures higher than the spin-fluctuation one. At high-temperature plateau is expected and a maximum may arise at lower temperatures depending on two parameters: the Stoner exchange-enhancement factor and the relative values of the Fermi wavelengths of the conduction and the interacting electrons. Possible fits are presented for the resistivities of palladium, neptunium, and plutonium and the case of strongly exchange-enhanced actinide compounds is also discussed. (auth)

7397 SPIN FLUCTUATIONS IN ACTINIDE INTERMETALLIC COMPOUNDS. Brodsky, M.B. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. B 9: No. 4, 1381-1387 (15 Feb 1974).

Electrical-resistivity and magnetic-susceptibility data for sixteen actinide systems are considered in terms of localized spin fluctuations (lsf). Each of the systems had been proposed earlier as an lsf system on the basis of a T^2 resistivity dependence at low temperatures. The data are examined at higher termperatures, and it is shown that the various temperature dependences predicted by Rivier and Zlatic for lsf dilute alloys are found in these ordered-lattice systems. Various spin-fluctuation temperatures (T_{SF}) are determined for each compound. By use of the Friedel–Anderson virtual-bound-state model, values of T_{SF} are calculated, and are shown to scale simply with T_{SF}'s estimated from the susceptibility data. The results are used to explain the lack of temperature-dependent susceptibilities for the pure lsf metals α-Np and α-Pu. (auth)

7398 SUPERCONVERGENCE AND SUM RULES FOR THE OPTICAL CONSTANTS: PHYSICAL MEANING, COMPARISON WITH EXPERIMENT, AND GENERALIZATION. Altarelli, M. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627); Smith, D.Y. Phys. Rev. B 9: No. 4, 1290-1298 (15 Feb 1974).

A physical interpretation of recently obtained sum rules for dielectric functions and for the index of refraction is provided in terms of the inertial properties of the linear dielectric response of material media. The superconvergent sum rules are then compared with experimental optical data for AgCl, Al, and Mo and shown to produce good agreement as well as a critical test of extrapolations and of Kramers–Kronig relations. A straightforward extension to higher powers of the optical constants and their moments is briefly discussed. (auth)

7399 OBSERVATION BY NUCLEAR ORIENTATION UNDER PRESSURE OF THE MAGNETIC STATE OF CERIUM IMPURITIES IN LANTHANUM. Benoit, A.; Delaplace, R.; Flouquet, J. (Laboratoire de Physique des Solides, Université Paris-Sud, Centre d'Orsay, 91405 Orsay, France). Phys. Rev. Lett. 32: No. 5, 222-224 (4 Feb 1974).

We describe nuclear-orientation experiments on LaCe alloys under pressure and show that, in an analyses with a minimum of parameters, dilute LaCe can be described by an ionic model in the pressure range studied (0–10 kbar). Our results are compared to indirect magnetic data extracted from measurements of transport properties. (auth)

Radiation Effects

Refer also to abstracts 5957, 6307, 7503, and 8304.

7400 (AD-769215) RADIATION-EMBRITTLEMENT RESISTANCE OF ADVANCED Ni–Cr–Mo STEEL PLATES, FORGINGS, AND WELDMENTS. Final report. Hawthorne, J. R. (Naval Research Lab., Washington, D. C. (USA)). 13 Sep 1973. Contract AT(49-5)-2110. 30p. (NRL-7573). NTIS $3.00.

The promise of selected nNiCrMo steels for advanced reactor vessel applications was demonstrated. Generally superior radiation embrittlement resistance, as well as superior preirradiation transition temperatures (Charpy-V 30-ft-lb index), was observed relative to the performance of A533 plates and welds of current usage. With only two exceptions, the A543 plates and A508 forgings examined showed sufficient resistance to a fluence of 4×10 to the 19th power n/cm^2 > 1 MeV to retain a subzero transition temperature. Weld deposits typically had higher postirradiation temperatures than parent plates. (GRA)

7401 (COO-3274-13, pp 1-16) QUADRUPOLE COUPLINGS OF ^{12}N AND ^{12}B IMPLANTED IN METAL SINGLE CRYSTALS. Haskell, R. C.; Correll, F. D.; Madansky, L. [nd].

In nuclear moments and nuclear structure. Annual progress report, June 1, 1973–April 30, 1974.

Measurements were made of the quadrupole couplings of ^{12}N implanted in single crystals of Be and Mg and of ^{12}B implanted in a single crystal of Zn. A comparison of the ^{12}N couplings in Be and Mg suggests that the final stopping sites of the implanted ^{12}N ions are substitutional sites, i.e., the ^{12}N ions occupy metal ion lattice positions, and the ^{12}N ions implanted in Be and Mg have the same charge state and quadrupole shielding factor. A procedure is outlined for deducing Q(^{12}N). The ^{12}B couplings in Zn imply the existence of two inequivalent stopping sites. The problems encountered in deducing Q(^{12}B) from couplings in hexagonal crystals are discussed. (3 figures, 3 tables) (auth)

7402 (COO-3274-13, pp 17-35) NUCLEAR MOMENTS PROGRAM: STOPPING SITES OF ^{12}B NUCLEI IMPLANTED IN

SINGLE CRYSTALS OF HEXAGONAL METALS. Correll, F. D.; Haskell, R. C.; Madansky, L. [nd].
In nuclear moments and nuclear structure. Annual progress report, June 1, 1973–April 30, 1974.

7403 (COO-3274-13, pp 50-64) FURTHER STUDIES OF TEMPERATURE SPIKES IN SOLIDS FOLLOWING COULOMB EXCITATION. Chien, C. L.; Walker, J. C.; Shnidman, R. [nd].
In nuclear moments and nuclear structure. Annual progress report, June 1, 1973–April 30, 1974.

7404 IRRADIATION INDUCED VOID SWELLING IN COLD WORKED TYPE 316 STAINLESS STEEL RESULTING FROM 5 MeV NICKEL ION BOMBARDMENT. Challenger, K. D. Jr. Cincinnati; Univ. of Cincinnati (1973). 208p. University Microfilms Order No. 74-2184.
Thesis (Ph. D.).
Irradiation induced void swelling in cold worked type 316 stainless steel (SS) has been studied by 5 MeV Ni ion bombardment at temperatures ranging from 475 to 725°C after ion doses causing up to 280 displacements per atom (dpa). The experiment is shown to be a valid simulation of in-reactor swelling up to 625°C provided the temperature shift in the range of swelling caused by the increased damage rate is accounted for. Thermal recovery of the cold work results in a swelling behavior of cold worked steel that gradually approaches that of annealed steel as the temperature is increased above 625°C. The dose dependence of swelling is expressed as a linear function, the rate and incubation dose for swelling decrease and increase respectively as the dislocation density is increased and temperature decreased. The temperature dependence of swelling is established for different degrees of cold work. A bell-shaped curve is observed with swelling occurring over the temperature range of 525 to greater than 725°C with a peak at 625°C independent of dislocation density. This peak swelling temperature corresponds to a reactor temperature of about 500°C. The dislocation density necessary to effect a substantial reduction in swelling increases with increasing dose and temperature. However, an upper limit to the amount of deformation that can be used to reduce swelling is imposed due to increased thermal instability. The optimum level of cold work from the standpoints of thermal stability and swelling resistance lies in the range of 10 to 30%. Widely varying swelling behaviors are observed for two different heats of nominally 20% cold worked type 316 SS. The magnitude of swelling at 625°C after 150 dpa varied from about one-third to two-thirds that of a comparably irradiated annealed steel (8 to 20%) due to this difference in swelling. Thus, core designs must continue to accommodate large uncertainties. These large uncertainties combined with the inherent thermal instability of cold worked steels strongly suggest that alternate LMFBR fuel clad materials be seriously considered. (Diss. Abstr. Int., B)

7405 NEUTRON IRRADIATION DAMAGE IN A PRECIPITATION-HARDENED ALUMINUM ALLOY. King, R. T.; Jostsons, A.; Farrell, K. (Oak Ridge National Lab., TN). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 165-180(1973).
A 6061 aluminum alloy target sleeve from the high flux isotope reactor, originally in a precipitation-hardened condition, was examined for neutron radiation damage after exposure to a maximum fast fluence of 9.2×10^{22} n/cm^2 (E > 0.1 MeV) and a thermal fluence of 1.38×10^{23} n/cm^2 at 60°C. Voids and a transmutation-produced silicon precipitate were found to cause about 1.1 percent internal swelling; a surface oxide scale contributed additional swelling. Irradiation-induced strength increases were measured at test temperatures in the range 25 to 200°C and are accounted for in terms of the observed silicon precipitate and an associated dislocation structure. There was also a loss of ductility that was most severe at 200°C. The fracture mode appeared to remain transgranular over the range of test temperatures. (auth)

7406 EFFECT OF ELECTRON IRRADIATION ON MICROHARDNESS OF Fe–Ni ALLOYS. Gruzin, P. L.; Machurin, E. S.; Vasil'ev, A. A.; Fomichev, V. Yu. Fiz. Metal. Metalloved.; 36: No. 4, 884-885(Oct 1973). (In Russian).
Experimental data indicated that not only are the structural defects retained but also point defects in the crystalline lattice convert from austenite to martensite. The removal of radiation hardening of martensite in annealing is considered due to disappearance of radiation defects. (tr-auth)

7407 RELATION OF IRRADIATION CREEP TO SWELLING. Brailsford, A. D.; Bullough, R. (Atomic Energy Research Establishment, Harwell, Eng.). pp 267-272 of Irradiation Embrittlement and Creep in Fuel Cladding and Core Components. London; British Nuclear Energy Society (1973).
From conference on irradiation embrittlement and creep in fuel cladding and core components; London, England (9 Nov 1972).
It is proposed that irradiation creep in solution-treated metals and alloys at temperatures just below or at peak swelling temperature occurs as a consequence of the anisotropy in the distribution of interstitial loop orientations; thus interstitial loops will nucleate more easily in an orientation sympathetic to the direction of the applied stress and the subsequent uniform growth of all the loops ensures that the body will then preferentially creep (or grow) in the stress direction. This mechanism for irradiation creep leads to a theoretical creep strain rate that is directly proportional to the swelling rate and, where the two have been simultaneously measured, leads to quantitative agreement with observation. The predicted dose and temperature dependence of the irradiation creep is also carefully correlated with the available relevant data and a useful upper bound for the expected creep rate at the peak swelling temperature is presented. (auth)

7408 SIMULATION OF IN-REACTOR CREEP OF TYPE 304 STAINLESS STEEL. Harkness, S. D.; Yaggee, F. L.; Nolfi, F. V. (Argonne National Lab., IL). pp 253-258 of Irradiation Embrittlement and Creep in Fuel Cladding and Core Components. London; British Nuclear Energy Society (1973).
From conference on irradiation embrittlement and creep in fuel cladding and core components; London, England (9 Nov 1972).
The merits of techniques available for simulating reactor-induced creep deformation are outlined and it is argued that the experimental requirements for macroscopic strain measurement and for dynamic viewing of lattice damage are mutually exclusive. Proton bombardment was observed to enhance primary creep in cold-worked but not in well annealed pure copper. The deformation rate increased linearly with applied stress; protracted transients were absent at both the onset and termination of irradiation. Electron irradiation in a high-voltage electron microscope revealed the occurrence of violent oscillations of internal stress which could be responsible for such an irradiation creep. (auth)

7409 ANALYSIS OF IRRADIATION-INDUCED CREEP OF STAINLESS STEEL IN FAST SPECTRUM REACTORS. Foster, J. P.; Wolfer, W. G.; Biancheria, A.; Boltax, A. (Westinghouse Electric Corp., Madison, PA). pp 273-281 of Irradiation Embrittlement and Creep in Fuel Cladding and Core Components. London; British Nuclear Energy Society (1973).
From conference on irradiation embrittlement and creep in fuel cladding and core components; London, England (9 Nov 1972).
The available stainless steel irradiation creep data from the EBR-II and DFR reactors were evaluated. Transient and steady state creep were observed. The steady-state creep rate data are linear with flux and time. The stress dependence of the solution-annealed types 304L, 304, and M316 stainless steels is linear, whereas the 20% cold-worked type M316 stainless steel exhibits linear behavior for equivalent stresses below 15,000 psi and a higher stress exponent for higher stresses. For solution-annealed materials, irradiation-induced creep increases in the order M316, 304, and 304L. Results of this analysis indicate that irradiation creep strain, e_i, can be described by an equation of the form: $e_i = A\sigma\bar{E}\phi + (B\sigma + C\sigma^3)\bar{E}\phi t$, where $\bar{E}$ is the average neutron energy, ϕ the total neutron flux, σ the applied stress, and A, B, C are material constants. The first term in the above equation defines the transient irradiation creep component. The fast reactor irradiation creep data are consistent with the concept of volume conservative strain. Significant high fluence irradiation creep information can be obtained from residual stress measurements on irradiation tubing. An analysis of this technique is presented including consideration of the fluence dependence of irradiation creep and swelling. (auth)

7410 POSSIBILITY THAT COTTRELL CREEP OCCURS WHEN NONFISSILE MATERIALS SUCH AS STAINLESS STEEL ARE IRRADIATED IN A FAST REACTOR. Gittus, J. H. (Atomic Energy Research Establishment, Harwell, Eng.); Anderson, R. G.; Makin, M. J. pp 291-301 of Irradiation Embrittlement and Creep in Fuel Cladding and Core Components. London; British Nuclear Energy Society (1973).
From conference on irradiation embrittlement and creep in fuel cladding and core components; London, England (9 Nov 1972).
The suggestion arose from the observation that the algebraic equation for I-creep (one of the earlier proposed mechanisms of irradiation-creep) is identical with that for Cottrell-creep if the yield point (Y) is used to estimate dislocation density. Cottrell's equation, however, applies even when sources of yield strength such as precipitates are present but under these circumstances use of the yield strength to estimate dislocation density in the I-creep equation would be erroneous. So I-creep and Cottrell creep only lead to the same equation in the case of a material that is hardened solely by dislocations. It is now shown that, since irradiation-induced dislocation climb is vir-

tually inexorable, the strains which it induces must be accommodated by dislocation glide even in the absence of external stress. An external stress (=σ) theoretically perturbs this glide, producing creep according to the Cottrell equation whatever the source of yield strength. If the random component of the irradiation induced dislocation-flux is $\dot{\gamma}_d Cm^{-1}sec^{-1}$ then the theoretical irradiation creep equation is $\dot{\epsilon}/\sigma \sim b\dot{\gamma}_d/I$ where b = Burgers vector and I the mean internal stress due to the conflicting internal strain rates. If the material is swelling (rate = Ṡ) then, theoretically, the number of irradiation-induced interstitialcies going to dislocation is at least equal to the number of vacancies going to voids. The creep inequality $\dot{\epsilon}/\sigma \geq \dot{S}/I$ then, theoretically, applies. The rates of creep ($\dot{\epsilon}$) predicted by these expressions are compared to those observed and reasonably good agreement is obtained. (auth)

7411 ESTIMATE OF THE COTTRELL CREEP OF A METAL DURING SWELLING. Anderson, R. G. (Atomic Energy Research Establishment, Harwell, Eng.); Ponter, A. R. S. pp 303-304 of Irradiation Embrittlement and Creep in Fuel Cladding and Core Components. London; British Nuclear Energy Society (1973).

From conference on irradiation embrittlement and creep in fuel cladding and core components; London, England (9 Nov 1972).

The Cottrell creep model which gave accelerated creep of uranium metal due to continuing, incompatible, self-cancelling, internal strains is extended to a simple model of a swelling material. An expression is presented relating the creep linearly to the applied stress and the fractional swelling and inversely to a representative stress in the material. The result is shown to be insensitive to the deformation mode of the material. (auth)

7412 EFFECT OF METALLURGICAL CONDITION AND IRRADIATION ON STRENGTH AND DUCTILITY OF Zr–1.14% Cr–0.1% Fe. Holt, R. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nucl. Mater.; 50: No. 2, 207-214(Mar 1974).

The mechanical properties of the alloy Zr–1.14% Cr–0.1% Fe in several metallurgical conditions are reported. The effect of irradiation at 573 and 723°K on the properties of α-annealed material and the effect of metallurgical condition on the properties of material irradiated at 573°K are given. Irradiation at 573°K reduced the tensile elongation but the alloy retained a high capacity for local strain after irradiation to a dose $\approx 1 \times 10^{24}$ n/m² > 1 MeV in all metallurgical conditions tested. Irradiation at 773°K had a small effect on the mechanical properties of α-annealed material and operation as a fuel sheathing at this temperature should not degrade the properties. The mechanical properties of this alloy appear promising for fuel-sheathing applications at both 573 and 773°K. (auth)

7413 IRRADIATION DAMAGE IN ZIRCALOY-2 PRODUCED BY HIGH-DOSE ION BOMBARDMENT. Lee, D.; Koch, E. F. (General Electric Co., Schenectady, NY). J. Nucl. Mater.; 50: No. 2, 162-174(Mar 1974).

Damage produced in Zircaloy-2 by 5 MeV Ni ion bombardment was examined by transmission electron microscopy. Nickel ion bombardment was done over an integrated flux ranging from about 5.6×10^{15} to 7×10^{16} Ni^{++} ions/cm² and over the temperatures from 300 to 600°C. The gross damage which occurred at low temperature consisted of dark unresolved areas and uniformly distributed "black dots", somewhat similar to those observed in neutron-irradiated Zircaloy. With increasing irradiation temperature and dose, two features have appeared in the microstructures. One of the features was randomly oriented dislocation loops and the other well-defined alignment of defects with the projection of aligned defects oriented in the $\langle 10\bar{1}0 \rangle$ directions. Detailed examination of these aligned defects revealed that they exhibit two kinds of images; one is associated with precipitation of second-phase material and the other with lattice displacement of matrix material. With further increase in irradiation temperature, the damage structure changed markedly to that of random dislocation network. (auth)

7414 EFFECT OF IRRADIATION ON THE MICROSTRUCTURE AND CREEP-RUPTURE PROPERTIES OF TYPE 316 STAINLESS STEEL. Bloom, E. E.; Stiegler, J. O. (Oak Ridge National Lab., TN). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 360-380(1973).

The effect of irradiation to fluences in the range 1.2 to 2.7×10^{22} n/cm² (>0.1 MeV) on the microstructure and creep-rupture properties of annealed and cold-worked Type 316 stainless steel has been examined for irradiation temperatures in the range 450 to 825°C. For irradiation in the annealed condition below about 650°C, voids and dislocations were formed. Cold working before irradiation suppressed void formation at all temperatures except 580°C where voids were occasionally found in recovered areas. Extensive precipitation occurred at temperatures above about 500°C, and the amount and type of precipitate were sensitive to the initial microstructure. Changes in rupture life and creep rate were observed, but the most significant effect of irradiation was a large decrease in ductility resulting from enhanced intergranular fracture. The grain boundary cracks were formed by the linking of cavities on those boundaries nearly normal to the applied stress. The experimental results are most consistent with a model in which nucleation of the cavities occurs on helium bubbles with growth controlled by stress-enhanced diffusion of vacancies. Experimental evidence also indicates that the strength of the matrix influences the crack propagation rate. (auth)

7415 GRAIN BOUNDARY MIGRATION DURING 1 MeV ELECTRON IRRADIATION. Singh, B. N.; Leffers, T. (Danish Atomic Energy Commission Research Establishment, Risoe). Scr. Met.; 8: No. 5, 549-552(May 1974).

Austenitic stainless steel foils with or without implanted He were irradiated by 1-MeV electrons at 600 and 650°C. After an initial period, migration away from the center of the irradiated grain occurs, and the migration rate increases with grain size. A possible mechanism for the directionality is suggested. (DLC)

7416 METHOD FOR REDUCING EMBRITTLEMENT CONDITION OF METALS. Richard, G. L.; Blosser, R. W. US Patent 3,804,734. 16 Apr 1974. Filed date 19 Apr 1972. 8p.

A method is described for reducing the condition of embrittlement in a metal specimen by irradiating the specimen with a neutron flux of selected density. The method consists of placing a metal specimen in a neutron radiation field for a pre-determined period of time in order to alleviate any embrittlement condition and/or to reduce likelihood of such condition at a later time, such neutron irradiation tending to rearrange the interstitial makeup of the metal specimen, e.g., by bringing about dissociation of diatomic or molecular hydrogen to its monatomic state. (Official Gazette)

7417 EFFECT OF FAST NEUTRON IRRADIATION ON THE RECRYSTALLIZATION OF COLD-ROLLED (110) [112] ORIENTED COPPER CRYSTALS. Haessner, F.; Holzer, H. P. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Acta Met.; 22: No. 6, 695-708(Jun 1974).

Copper single crystals with the orientation (110) [$\bar{1}$12] were rolled to a cross-sectional reduction of 98.5%, reversing end-for-end between passes, and then irradiated with neutrons up to integrated doses of 5×10^{19} neutrons/cm^{-2} (E > 0.1 MeV). Control specimens were first irradiated and then rolled. The migration velocity of individual grain boundaries in the deformed matrix and in the recrystallized material was determined by optical microscopy and x-ray methods after various heat treatments. The velocity of a given grain boundary increases with increasing neutron irradiation in the case of unimpeded grains. The activation energy of migration is independent of the irradiation. The microstructure on completion of primary recrystallization becomes increasingly finely grained with increasing neutron irradiation but the texture remains unchanged. A quantitative interpretation of these phenomena is suggested based on the existence of irradiation-induced vacancy loops in the matrix. At low annealing temperatures these loops are absorbed into migrating grain boundaries, the mobility of which is thereby increased. At high annealing temperatures they dissociate and bring about a short-term increase in the self-diffusion coefficient, thereby increasing the nucleation rate. (auth)

7418 INFLUENCE OF HELIUM DISTRIBUTION AND GRAIN SIZE ON HIGH-TEMPERATURE-EMBRITTLEMENT OF STAINLESS STEEL. Furuta, T.; Kawasaki, S. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 50: No. 3, 275-280 (Apr 1974).

In order to study the high-temperature embrittlement related to helium from the viewpoint of the distribution of helium and the grain size, helium (7.5×10^{-4} atomic fraction) was injected into stainless steel, treated in various ways, using a cyclotron. Helium retarded the tendency towards recrystallization of stainless steel, and the grain size of the specimen recrystallized after injection was clearly smaller. The high-temperature embrittlement related to helium in stainless steel was appreciable above 650°C, and could be classified in terms of the mean grain diameter and the distribution of helium. (auth)

7419 EFFECT OF NEUTRON IRRADIATION ON DIFFUSION OF GOLD AND COPPER IN ALUMINUM AT INFINITE DILUTION. Acker, D.; Beyeler, M.; Brebec, G.; Bendazzoli, M.; Gilbert, J. (CEN, Saclay, France). J. Nucl. Mater.; 50: No. 3, 281-297 (Apr 1974). (In French).

The enhancement of gold and copper diffusion in aluminum irradiated with neutrons was measured. Under the irradiation conditions (1.5×10^{-6} displacements/atom/s) the observed enhancement varies from 10^3 to 0 when T increases from 35 to

220°C. In assuming that only interstitials and vacancies are mobile it was found that interstitials contribute more than vacancies to the enhancement. This conclusion is only valid if the assumption of local equilibrium under irradiation (equilibrium between solute, point defects, and complexes) used in the calculation is verified. The possibility of an important contribution of divacancies to the enhancement of diffusion cannot be disregarded. (auth)

7420 PARTICLE RELEASE FROM NIOBIUM IRRADIATED WITH 14-MeV NEUTRONS. Kaminsky, M.; Peavey, J.H.; Das, S.K. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 32: No. 11, 599-602 (18 Mar 1974).

The particle release from cold-rolled niobium surfaces under 14-MeV-neutron impact to a total dose of 4.6×10^{15} neutrons/cm^2 was investigated under ultrahigh-vacuum conditions and at ambient temperature. The type and amount of material released and deposited on a substrate surface was determined independently by four analytical techniques. Surprisingly, there were two types of deposits—one in the form of large chunks, the other a more even layer covering the surface. The chunk emission cannot be explained by existing neutron-sputtering theories. (auth)

Other Materials

Refer also to abstracts 6077, 6094–6097, 6601, 6777, and 7318.

7421 (CONF-730942-P6A-S, pp vp Paper H 6/1) HEAT AND MOISTURE TRANSFER IN CONCRETE UNDER THE EFFECT OF A TEMPERATURE GRADIENT. Hundt, J.; Schimmelwitz, P. (Bundesanstalt fuer Materialpruefung, Berlin). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany. (10 Sep 1973).

Concrete consists of cement paste, aggregate, water and air. During hardening the ratios of solid, liquid and gaseous matter are changing. This process called maturing can mainly be influenced by the composition of the initial mix and by curing. Regarding the development of the pore system which is directly determined by this process, the water/cement ratio is the essential technological parameter. With respect to moisture transport, the pore system has to be considered as the most influencing parameter. To describe this pore space sufficiently, in particular the pore size distribution and the understanding of the pore shapes and the configuration of different pores with respect to one another are needed. Experimental results have shown that the pore size distributions are differing widely depending on the degree of maturity, in particular the number of small pores is increasing with the rise of age. Also the phenomena of moisture transport in large concrete bodies caused by heating from one side are under experimental investigation in the BAM. They are carried out in concrete beams in which heat and moisture transport can be regarded in first approximation as one-dimensional in the direction of the beam axis. After some months of heating time, three areas can be distinguished in the moisture distribution: in the immediate vicinity of the heating plate (up to about 30 cm) the largest changes occurred. The adjoining area (between about 30 cm and 200 cm) shows an approximately constant moisture distribution, however, between 60 cm and 80 cm a small increase of moisture content is noticeable which seems to indicate a kind of deceleration effect. To predict the development in time of the moisture distribution in large concrete elements the dependence on maturity of the relevant material characteristics has to be taken into account. The phenomena relevant for the heat and moisture distribution are superposing and depending upon one another. Thus, a general mathematical description has to be based on a nonstationary flow of heat and moisture. 6 references. (auth)

7422 (DNA/2881-F-1) SOURCEBOOK OF RADIATION EFFECTS ON PROPELLANTS, EXPLOSIVES, AND PYROTECHNICS. Volume 1. Final Report. Paitchel, H.; Cockayne, J. E.; Alger, R. S.; Elsberry, R. T.; Thomas, W. B.; McSwain, J. M. (Picatinny Arsenal, Dover, N. J. (USA)). 1 Jan 1974. 318p. NTIS.

This is volume I of a two-volume sourcebook dealing with the nuclear survivability of propellants, explosives, and pyrotechnics (so-called PEP materials). Volume I provides the background information needed to make full use of volume II, which deals specifically with PEP nuclear survivability. Volume I covers two main subjects on an introductory basis: (1) nuclear radiation and its interaction with matter; (2) technology of propellants, explosives, pyrotechnics, and various electroexplosive devices used in aerospace weapon systems. (auth)

7423 (UCRL-75279) LOW-TEMPERATURE, THERMAL, AND MECHANICAL PROPERTIES OF POLYSTYRENE AND POLYETHYLENE FOAMS. Foley, R. J.; Jelinek, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Dec 1973. 12p. (CONF-740509-2). Dep. NTIS $4.00.

From fifth international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The storage of cryogenic fluids in stationary and transport vessels demands a continual evaluation of thermal and mechanical properties of materials that are candidates for use as insulation materials. An evaluation of several materials being considered for use in experimental cryogenic storage vessels is presented. The materials studied were polystyrene and polyethylene foams of varying density. The properties measured were thermal contraction, thermal conductivity, and ultimate compressive and tensile strengths. (auth)

7424 DEPENDENCE OF THE STRENGTH PROPERTIES OF GRAPHITE ON ITS TREATMENT TEMPERATURE. Virgil'ev, Yu. S.; Kurolenkin, E. I.; Makarchenko, V. G.; Pekal'n, T. K. Probl. Prochnosti; 5: 43-46(Nov 1973).

Investigation was conducted of the temperature dependences of the compressive strength, the elastic modulus, and the hardness of carbon materials and their relations with the crystalline structure of the materials in the treatment temperature range from 1300 to 3000°C. A decrease in the values of the investigated strength parameters with an increase in the treatment temperature is noted. A relation is established between the strength and the diameter of the regions of coherent scattering in the treatment temperature range from 2000 to 3000°C, and an estimate is made of the effect of the internal specific surface of the pores on the strength at temperatures below 2000°C. (IAA)

7425 MICROSTRUCTURE OF BRAZED JOINTS PRODUCED BY THE ACTIVE BRAZING OF GRAPHITE WITH Au/Mo/Ni FILLER METAL. Nesse, T. (DEGUSSA, Grossauheim, Ger.). Prakt. Metallog.; 11: No. 2, 77-82(Feb 1974). (In German and English).

Active brazing alloys on Au/Ni/Mo base show poor spreading behavior in spite of small wetting angles. Therefore, infiltration does not occur even in graphite specimens with large pores. Metallographic investigations showed that a continuous Mo layer had formed in the brazing alloy at some distance from the parent material. In the region between parent material and Mo layer, only Au/Ni solid solution is present. The residual brazing alloy consists of Ni and Mo containing precipitates in a Au/Ni matrix. (GE)

7426 HEAT TRANSPORT MEASUREMENTS IN POLYCRYSTALLINE GRAPHITES UP TO 2600°C. Report on an International Cooperative Measuring Programme. Weisenburger, S. (Univ., Karlsruhe, Ger.). High Temp.–High Pressures; 5: No. 4, 475-480(1973).

As part of an international cooperative measuring programme, ten independent laboratories have measured thermal diffusivity, thermal and electrical conductivity, and specific heat of AXM-5Q and RVD fine-grained graphites on samples from the same stocks, using different apparatus and methods. The experimental results are presented and discussed with reference to the methods used and the precision and accuracy of the results. AXM-5Q graphite is considered to be a suitable reference material for thermophysical property measurements at high temperature. Extrapolation to high temperatures of thermal conductivity data obtained at moderate temperatures gives for graphite results which are consistent with thermal conductivity values calculated from high-temperature thermal diffusivity data. (auth)

7427 IRRADIATION AND ANNEALING EFFECTS ON THE C-AXIS ELECTRICAL RESISTIVITY OF GRAPHITE. Iwata, T.; Nihira, T.; Matsuo, H. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 36: No. 1, 123-129(Jan 1974).

Changes in the c-axis electrical resistivity of pyrolytic graphite due to electron irradiations at 80°K and due to subsequent isochronal pulse annealings up to 400°K were measured. The average carrier mobility in the c-axis direction was calculated from the c-axis resistivity by the use of the carrier density obtained through the a-axis galvanomagnetic property measurements. The c-axis resistivity decreased by irradiation at 80°K. The reciprocal of the average carrier mobility in the c-axis direction increased by 7 ± 2 mV · sec · cm^{-2} per ppM of Frenkel defects. As to thermal annealings, the c-axis electrical resistivity showed peculiar features compared with the a-axis one. The reciprocal of the average carrier mobility in the c-axis direction, however, showed nearly the same changes in relative values as that in the a-axis direction with annealing temperatures. (auth)

7428 POSITRON ANNIHILATION CHARACTERISTICS OF POSITRONIUM OXIDES, SULFIDES, ETC. [$X^{+}e^{+}$]: IMPLICATIONS FOR OXIDE AND SULFIDE CRYSTALS. Cade, P. E.; Farazdel, A.

(Univ. of Massachusetts, Amherst). Solid State Commun.; 14: No. 9, 807-810(1 May 1974).

Theoretical Hartree–Fock calculations are summarized for the $[X^{=}e^{+}]$ systems with X = O, S, Se, and Te which establish the stability of bound states for the system. The two-photon annihilation lifetime, τ, and angular correlation, $N(\Theta)$, are calculated and positron annihilation from alkaline earth oxides is discussed. (auth)

7429 INTERFACES IN CARBON FIBER/PYROLYTIC–CARBON MATRIX COMPOSITES. Butler, B. L.; Northrop, D. A.; Guess, T. R. (Sandia Labs., Albuquerque, NM). J. Adhes.; 5: 161-178(1973).

Carbon fiber/pyrolytic-carbon matrix composites contain both fiber-matrix and matrix-matrix interfaces and, thus, do not fit the usual concept of fiber-reinforced composite materials. This is a consequence of the chemical vapor deposition (CVD) process in which the matrix forms uniform pyrocarbon sheaths around each fiber and ultimately results in matrix-matrix interfaces with various geometries and also produces large oriented voids. The role of the fiber-matrix and matrix-matrix interfaces on the mechanical composite properties has been examined by mechanical testing and optical and scanning electron microscopy. Results are presented for increasingly complex fibrous substrate geometries with a pyrolytic carbon matrix: single fiber, strand, or yarn bundle and circumferential and angle-ply filament-wound cylinders. Data for coated single fibers demonstrate the adequacy of the fiber-matrix interface and the applicability of the rule-of-mixtures to this simple composite. The degree of utilization of these coated fiber units in composite structures, however, is determined by the geometry and strength of the matrix-matrix interface, which in turn, is influenced by the microstructure and properties of the pyrolytic carbon. Observed strengths of unidirectional, infiltrated strands are significantly lower than the strengths of the coated single fiber units of which they are composed. This is because the brittle matrix-matrix interfaces are unable to distribute the load equally between the fiber-matrix units or to redistribute the load around individual unit failures. Attempts to predict strengths for complex angle-ply composites from these unidirectional constituent properties have been only partially successful, as the important role of the matrix-matrix interface has not been adequately quantified. However, optical examination of failure surfaces as a function of fiber modulus and matrix microstructure allows a qualitative interpretation to be made. (auth)

7430 CHEMICAL PROPERTIES OF THE HYDRIDES OF EUROPIUM AND YTTERBIUM. Mikheeva, V. I.; Kost, M. E.; Konstantinova, A. I. pp 154-158 of Khimiya Metallicheskikh Splavov. Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The relation of the hydrides of Eu and Yb to different chemical agents (such as oxygen, water, acids, and lithium hydride) was studied. Europium dihydride in its chemical activity is close to the hydrides of the alkali earth metals. A lesser chemical activity was noted for ytterbium hydride. A hypothesis was made on the anion character of hydrogen to the hydrides of the rare earth metals. (tr-auth)

7431 MAGNETIZATION OF RARE EARTH MATERIALS. Stewart, A. M. (Univ. of New South Wales, Kensington, Australia). Aust. J. Phys.; 27: No. 1, 139-141(Feb 1974).

The formal procedure is demonstrated for calculating the magnetization of a rare earth material, in the mean field approximation, at arbitrary fields and temperatures when account is taken of crystal-field splittings, interionic exchange interactions and conduction electron polarization effects. (auth)

7432 COEFFICIENT OF THERMAL EXPANSION AND DYNAMIC MECHANICAL PROPERTIES OF AS-DEPOSITED AND STRESS-GRAPHITIZED PYROLYTIC CARBON. Lindquist, K. O.; Blankenhorn, P. R.; Kline, D. E. (Pennsylvania State Univ., University Park). J. Nucl. Mater.; 50: No. 3, 311-314 (Apr 1974).

Data are presented on the coefficient of thermal expansion (CTE) in the c-direction of as-deposited and stress-graphitized pyrolytic carbon (PC) at 100 to 300°K. The CTE was determined using a laser interferometer apparatus. The data are presented in graphs and tables showing that the dynamic modulus anomaly occurring in pyrolytic carbon at 240°K does not occur in irradiated PC. (JRD)

7433 SPECIFIC HEAT AND MAGNETIC PHASE TRANSITION IN $LaVO_3$. Borukhovich, A.S.; Bazuev, G.V.; Shveikin, G.P. (Institute of Chemistry, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.–Solid State 15: No. 7, 1467-1468 (Jan 1974).

The specific heat of $LaVO_3$ in the temperature range $0.38 \leq T/T_{N2} \leq 2/2$, including the magnetic disorder point, which is located at $T_{N2} = 133.70$°K has been experimentally determined. (AIP)

7434 ELECTRON SPIN RESONANCE OF DIPOLE-COUPLED ION PAIRS IN ORTHORHOMBIC POTASSIUM–YTTRIUM MOLYBDATE. Pshisukha, A.M.; Zvyagin, A.I. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Solid State 15: No. 7, 1341-1343 (Jan 1974).

An analysis of the ESR spectrum of pairs of interacting Dy^{3+} ions in $KY(MoO_4)_2$ shows that the spectrum is mainly due to an anisotropic dipole–dipole interaction. It is also shown that the absorption of microwave radiation polarized parallel to the external static magnetic field is due to the low symmetry of the investigated crystal and the presence of geometrically inequivalent paramagnetic centers. (auth)

7435 VIRTUAL CHARGE EXCHANGE AS A MECHANISM OF NON-RADIATIVE TRANSITION BETWEEN TERMS OF RARE-EARTH IONS IN SCHEELITE AND FERGUSONITE TYPE CRYSTALS. Reut, E.G.; Ryskin, A.I. Opt. Spectrosc. (USSR) 35: No. 5, 501-504 (Nov 1973).

In this work it is shown that for rare-earth (RE) ions with fluctuating valences (Pr, Tb, Eu, Tu, Yb) in crystals of the scheelite and fergusonite types, de-excitation can take place through interaction with charge transfer states (virtual charge exchange). The transition of an electron from a RE ion level to a charge transfer state can come about by tunneling (Pr^{3+}) or by classical passage of the electron over the barrier. In the latter case the process is possible only at elevated temperatures (Eu, Tb). Two possible schemes of charge exchange are examined corresponding to the oxidation–reduction properties of the crystals under study. (auth)

7436 TEMPERATURE QUENCHING OF URANIUM LUMINESCENCE IN SCHEELITE-TYPE SINGLE CRYSTALS. Morozova, L.T.; Feofilov, P.P. Opt. Spectrosc. (USSR) 35: No. 4, 458-459 (Oct 1973).

The temperature quenching of the red luminescence of hexavalent uranium in single crystals of a scheelite type structure was investigated. The luminescence has been attributed to tetrahedral UO_4^{2-} complexes formed by isomorphic replacement of Mo^{6+} or W^{6+} ions by U^{6+} ions. (AIP)

7437 TEMPERATURE BROADENING AND SHIFT OF PHONONLESS LINES IN THE SPECTRA OF CRYSTALLINE URANYL COMPOUND WITH A POLYMER-TYPE STRUCTURE. Shchelokov, R.N.; Ellert, G.V.; Karasev, V.E.; Krasilov, Y.I.; Gaevoi, G.M. Opt. Spectrosc. (USSR) 35: No. 5, 570-571 (Nov 1973).

The results of an investigation of the effect of temperature on the shift, width and shape of phononless lines of crystalline compounds of uranium, cesium trisulfatediuranylate and sodium phosphatodioxalatouranylate are reported. Based on analysis of the shape of the lines investigated, it is proposed that the broadening of the lines is determined by an intramolecular mechanism of interaction of the uranylate center with its environment, while the temperature shift is substantially determined by the structure of the phonon spectrum of the crystal. (AIP)

7438 TEMPERATURE DEPENDENCE OF THE LIFETIME OF EXCITED UO_2^{2+} IONS IN FROZEN SULFURIC ACID SOLUTIONS: ROLE OF STRUCTURAL TRANSITIONS. Kazakov, V.P.; Korobeinikov, V.N.; Chuvilin, Y.N.; Rykova, V.V.; Kovelzon, I.G. Opt. Spectrosc. (USSR) 35: No. 5, 576-577 (Nov 1973).

Photoluminescence measurements have been made on 17.5 M and 5 M H_2SO_4 frozen solutions of UO_2^{2+} ions. These measurements indicate that the temperature dependence of the fluorescence intensity and consequently the radiationless deactivation of the excited UO_2^{2+} ions in sulfuric acid solutions are not produced by a single activation process of thermal quenching. The structural transitions taking place in the acid in certain temperature ranges play a very essential, and sometimes a predominant part. (AIP)

7439 SPECIAL FEATURES OF LUMINESCENCE OF A Pr^{3+} ION IN SCHEELITE-TYPE CRYSTALS UNDER EXCITATION INTO THE CHARGE TRANSFER BAND. Reut, E.G.; Ryskin, A.I. Opt. Spectrosc. (USSR) 35: No. 4, 391-393 (Oct 1973).

It is found that in scheelite-type crystals luminescence of the Pr^{3+} ion is excited in the charge transfer band. The strong dependence of the position of the charge transfer band on the structure of the center makes it possible to achieve separate excitation of tetragonal and locally compensated centers. Investigation of the position of the charge transfer band for different centers showed that nontetragonal centers in scheelite-type crystals with cation compensation and without a compensator are caused by an increase of crystal defects upon heterovalent activation and by the distribution of a certain number of rare earth ions in defect positions. (auth)

7440 ENTHALPY OF FORMATION OF GERMANIUM TRIFLUORIDE. Wang, J.L.; Margrave, J.L.; Franklin, J.L. (Rice University, Department of Chemistry, Houston, Texas 77001). J. Chem. Phys. 60: No. 5, 2158-2162 (1 Mar 1974).

The formation of negative ions resulting from the electron bombardment of germanium tetrafluoride has been studied as a function of the electron energy. Appearance potentials of these ions were determined and measurements of their excess kinetic energies were made for the dissociative electron attachment in order to estimate values for the enthalpy of formation of germanium trifluoride and its electron affinity. (auth)

7441 RADIATION HARDENING AND PRESSURE-ACTUATED CHARGE RELEASE OF ELECTRON-IRRADIATED TEFLON ELECTRETS. Gross, B.; Sessler, G.M.; West, J.E. (Bell Telephone Laboratories, Murray Hill, New Jersey 07974). Appl. Phys. Lett. 24: No. 8, 351-353 (15 Apr 1974).

The radiation-induced conductivity (RIC) of Teflon is greatly reduced after bombardment with massive doses of the order of 100 Mrad. Such a "radiation-hardened" Teflon film can store a considerably larger amount of negative charge in vacuum than nonhardened Teflon films. The stored charge is, however, released within a short time when the dielectric is brought up to air pressure. This charge release occurs partly as disruptive internal discharge at pressures below 1 Torr and partly as continuous charge release at higher pressures. (auth)

7442 STIMULATED EMISSION FROM (Er,Lu)AlO_3 CRYSTALS CONTAINING Ho^{3+} AND Tm^{3+} IONS. Bagdasarov, K.S.; Kaminskii, A.A.; Kevorkov, A.M.; Sarkisov, S.E.; Tevosyan, T.A. (Institute of Crystallography, Academy of Sciences of the USSR). Sov. Phys.-Crystallogr. 18: No. 5, 681-681 (Mar 1974).

The luminescence spectrum of (Er,Lu)AlO_3 crystals containing Ho^{3+} and Tm^{3+} activator ions has been investigated at 77°K. These crystals were found to have potential for use in continuously operating lasers. (AIP)

7443 MOLECULAR SCATTERING OF LIGHT IN A SINGLE CRYSTAL OF HAFNIUM DIOXIDE. Aleksandrov, V.I.; Kitaeva, V.F.; Kozlov, I.V.; Osiko, V.V.; Sobolev, N.N.; Tatarintsev, V.M.; Chistyi, I.L. (Physics Institute, Academy of Sciences, of the USSR). Sov. Phys.-Crystallogr. 18: No. 5, 682-684 (Mar 1974).

Elastic and photoelastic constants of a HfO_2-10% Y_2O_3 solid solution crystal have been determined from polarized light scattering and sound wave velocity measurements. (AIP)

7444 STRUCTURE OF THE DOUBLE OXIDE α-$U_3Mo_{20}O_{64}$ Serezhkin, V.N.; Kovba, L.M.; Trunov, V.K. (M. V. Lomonosov Moscow State University). Sov. Phys.-Crystallogr. 18: No. 5, 603-605 (Mar 1974).

By means of x-ray structural analysis of single crystals (KFOR camera, Mo Kα, 640 independent reflections, R=0.155), the authors have established the structure of the double oxide α-$U_3Mo_{20}O_{64}$, which is orthorhombic with unit-cell parameters a=8.246, b=28.76, c=19.78 A, Z=4, sp. gr. Cccm. Perpendicular to the c direction there are infinite layers with the composition Mo_2O_7 (the "thickness" of a layer corresponds to two MoO_6 octahedra linked by a common vertex). The U, Mo, and O atoms, lying between the layers, are joined into infinite metal-oxygen chains running parallel to the a direction. The coordination polyhedra of the U atoms are hexagonal bipyramids; those of the Mo atoms are octahedra. These results enable us to regard the double oxide α-$U_3Mo_{20}O_{64}$ as the result of replacing some of the U atoms by Mo atoms in the structure of the double β-UMo_2O_8. (auth)

7445 RADIATION PROTECTION OF FIBER OPTIC MATERIALS: EFFECTS OF OXIDATION AND REDUCTION. Friebele, E.J.; Ginther, R.J.; Sigel, G.H. Jr. (Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 24: No. 9, 412-414 (1 May 1974).

The response to ionizing radiation of a suite of high-purity silicas, a titanium-doped silica, high-purity germania, and silica fibers with germanium-doped and titanium-doped cores has been measured. The radiation sensitivity of these materials was found to depend upon the atmosphere used during a heat treatment prior to irradiation. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 6192 and 8652.

7446 (IFA-SR-8-1974) FEASIBILITY STUDY FOR THE SAFEGUARDS USE OF NMR METHODS FOR THE ISOTOPIC ASSAY OF ^{235}U IN UF_6 STREAMS WITH DIFFERENT ENRICHMENTS. Ursu, I.; Demco, D. E.; Simplaceanu, V.; Vilcu, N. (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The possibility of using NMR methods for the isotopic assay of ^{235}U in UF_6 was investigated. Direct detection of ^{235}U by NMR is not feasible due to the small magnetogyric ratio and low sensitivity of this nucleus. An indirect detection method would be more suitable. Such an indirect technique is the determination of the transverse relaxation rate T_2^{-1} of the ^{19}F nuclei in liquid UF_6. This parameter was found to be strongly dependent on the ^{235}U enrichment of UF_6. The measurements were performed by using a commercial pulsed NMR spectrometer Bruker B-KR 322s on five UF_6 samples with different known enrichments. T_2^{-1} measurements showed only a reduced dependence of the longitudinal relaxation rate of the ^{19}F nuclei on the ^{235}U enrichment. An explanation of this effect is given. The isotopic assay of ^{235}U in liquid UF_6 based on T_2^{-1} determinations is thought to be feasible under some precautions regarding the chemical purity of the samples and the elimination of some sources of errors in T_2^{-1} measurements. (auth)

7447 (LA-5317) ERROR ANALYSIS OF A ^{252}Cf FUEL-ROD-ASSAY SYSTEM. Forster, R. A.; Smith, D. B.; Menlove, H. O. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 34p. Dep. NTIS $4.00.

An error analysis of a nondestructive assay system designed to measure rapidly and accurately the total fissile content of homogeneous, unpoisoned, low-enrichment (<5% fissile content by weight), nuclear-reactor fuel rods or small samples is presented. The assay system uses thermal-neutron interrogation to induce fissions in the sample. The resultant high-energy fission neutrons are counted using energy-biased neutron detectors, and the count rate is converted into total fissile mass in the material by using known standards. The contributions of several possible sources of error to the uncertainty in the total fissile-assay result are considered: (1) uniqueness of the measured response to the fissile content of the rod, (2) system calibration, (3) precision, and (4) effects of geometric and loading variations in the fuel rods. These general considerations are applicable to any similar assay system that produces an absolute measurement by comparison to known standards. The overall conclusion is that, with suitable standards and proper calibration, the fuel-rod-assay system can assay a large number of rods so that the uncertainty in the assayed total fissile mass is <0.5% (2σ). (auth)

7448 OPERATIONAL EXPERIENCE WITH THE AUTOMATIC LEAD-SPECTROMETER FACILITY FOR NUCLEAR SAFEGUARDS. Krinninger, H. (INB, Bensberg, Ger.); Ruppert, E.; Siefkes, H. Nucl. Instrum. Methods; 117: No. 1, 61-84(1974).

In 1969 INTERATOM received a contract from the Karlsruhe Nuclear Research Centre for the development, design and construction and start-up of an automatic lead-spectrometer facility for controlling the flow of fissile material at the product end of a LWR fuel-pin fabrication plant. The main features of the plant design are the application of pulsed-neutron active-interrogation technique with multi-isotope fissile-material assay capability, the adaptability to customers requirements, the design for heavy-duty operation and its simplicity and ease of operability. An on-line process-computer system coordinates and controls the sequence of the measurements, surveys the plant operation and is responsible for data acquisition and evaluation. The evaluation program, as organized, includes self-checking possibilities to detect malfunctioning of component parts. To minimize evaluation errors, this program is capable of differentiating between fuel pins with varying pellet column lengths and/or pins with varying enrichment as compared to a reference pin. Subsequent to the testing of the plant components, a continuous operation under field conditions was carried out. During this test, fulfillment of the specification, performance of the components, reproducibility, availability, safety and assay accuracy could be demonstrated. After a training period of four weeks, the operation of the plant was taken over by a technician. (auth)

7449 NONPROLIFERATION TREATY OF NUCLEAR WEAPONS AND THE PROBLEM OF SAFEGUARD GUARANTEES. Kohler, B. Ruestungsbeschraenkung und Sicherheit, Volume 9. Frankfurt am Main; Metzner (1972). 214p. (In German).

The book deals, from the viewpoint of international laws, with the concept of guarantee as a regulator of international relations and the concept of nonproliferation as an instrument to ensure peace. The negotiations and safeguard problems in connection with the nonproliferation treaty (NPT) are reported with respect to the special problems of the Federal Republic of Germany, Japan and India. The book concludes with the full text reproduction of the NPT and with comprehensive bibliographical data. (GE)

7450 RADIOACTIVE CONTAMINATION IN THE CONTEXT OF THE ENERGY CRISIS. Atoomenergie Haar Toepass.; 16: No. 1, 7-10(Jan 1974). (In Dutch).

From 23rd Pugwash conference; Aulanko, Finland (30 Aug 1973).

The report of a working party of the 23rd Pugwash Conference, Aulanko, Finland, 30 Aug. to 4 Sept. 1973 is summarized. The need for increasing dependence on (fissile) nuclear fuels is recognized, but more stringent safeguards are recommended, particularly against the inadvertent release of radioactivity into the atmosphere. Special caution is urged in the development of fast breeder programs, involving large plutonium inventories. (NL)

7451 PUGWASH, THE NETHERLANDS, AND KALKAR. Goedkoop, J. A. (Stichting Reactor Centrum Nederland, The Hague). Atoomenergie Haar Toepass.; 16: No. 1, 11-13(Jan 1974). (In Dutch).

The ways in which the Pugwash (1973) Working Party proposals might affect the joint W. German-Benelux, Kalkar fast reactor program are considered. The problems of plutonium management, storage and security in the Netherlands are discussed. (NL)

Disposal and Storage

Refer also to abstracts 6167, 6169-6171, 6193, 6195, 6479, 6532, and 6537.

7452 (ARH-SA-178) DURABILITY EVALUATION OF RADIOACTIVE WASTES IN CERAMIC FORM. Brownell, L. E.; Isaacson, R. E.; Ogren, W. E.; Griffing, D. E. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2130. 26p. (CONF-740438-1). Dep. NTIS $4.50.

From annual meeting of the American Ceramic Society; Chicago, Illinois, USA (28 Apr 1974).

Durable radioactive waste product forms are required to assure their safe storage during the long time required for radioactive decay. Leaching tests with water are used as a measure of the durability of the waste product form. Experimental data have been accurately fitted with a polynomial equation, the terms of which can be related to leaching mechanisms. The mechanisms of ideal diffusion and chemical attack processes are a function of time to the one-half power and first power, respectively. The generalized equation for the total fraction leached, f_t, up to and including complete leaching, as a function of time, t, of a durable waste product has the form: $f_t = \sum_{i=0}^{m} z_i k_i t^{i/2} / 1 + k_i t^{i/2}$ where k_i is the leading coefficient and z_i is the phase affected by the leading mechanism. (auth)

7453 (BNWL-B-223-9) ADVANCED WASTE MANAGEMENT STUDIES. Progress Report, October-December 1973. Schneider, K. J. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 67p. Dep. NTIS $6.50.

A study and evaluation of currently envisioned, potential, long-term, radioactive waste management concepts is presented. The purpose of the study is to identify feasible long-term waste management systems and their components, identify the research and development necessary for their establishment, and estimate the schedule and costs associated with selected systems. The study is being conducted so that alternative waste management systems can be evaluated on common bases and the future course of development for long-term management systems can be planned. Three basic types of waste management concepts are under study: (1) terrestrial disposal, (2) extraterrestrial disposal, and (3) transmutation processing. The terrestrial concepts involve disposal of waste in geologic formations, ice sheets, and seabeds. The extraterrestrial concept involves disposal of waste to various locations

in space. Transmutation involves partial elimination of some offensive waste nuclides. There are several sub-concepts within each major concept (e.g., transmutation by accelerators, fission reactors, or fusion reactors). Each concept is being evaluated in terms of the total waste management system needed to support it. (auth)

7454 (ICP-1042-1) SURVEY OF NRTS WASTE MANAGEMENT PRACTICES. Volume I. Hogg, G. W.; Holcomb, W. F.; Lakey, L. T.; Jones, L. H.; Coward, D. D. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs—Operations Office). Sep 1971. Contract AT(10-1)-1375. 123p. Dep. NTIS $9.25.

Waste management and pollution control practices at the NRTS were studied to allow definition of the requirements for a progressive long-range waste management and pollution control program. Detailed descriptions of the NRTS first-order waste generators and waste handling practices are provided. The NRTS wastes are summarized by waste type, contaminant type, waste generating equipment, and waste handling equipment. The results of a literature survey of practices at other sites, technology, and regulations applicable to the NRTS are presented. Data were obtained from the survey that provided a basis for a long-range NRTS waste management and pollution control program. Recommendations for a long-range program which will help insure compliance with present and future regulations and directives are outlined. The summary, results of the literature survey, and recommendations and conclusions are presented in Volume I of this document. The detailed descriptions of the NRTS primary waste generators and waste handling practices are provided in Volume II. (auth)

7455 (ICP-1042-2) SURVEY OF NRTS WASTE MANAGEMENT PRACTICES. Volume II. Hogg, G. W.; Holcomb, W. F.; Lakey, L. T.; Jones, L. H.; Coward, D. D. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs—Operations Office). Sep 1971. Contract AT(10-1)-1375. 351p. Dep. NTIS $20.75.

Waste management and pollution control practices at the NRTS were studied to allow definition of the requirements for a progressive long-range waste management and pollution control program at the NRTS. Detailed descriptions of the NRTS first-order waste generators and waste handling practices are provided in this report. The NRTS wastes are summarized by waste type, contaminant type, waste generating equipment, and waste handling equipment. The results of a literature survey of practices at other sites, technology, and regulations applicable to the NRTS are presented. Data were obtained from the survey that provided a basis for a long-range NRTS waste management and pollution control program. Recommendations for a long-range program which will help insure compliance with present and future regulations and directives are outlined. The summary, results of the literature survey, and recommendations and conclusions are presented in Volume I of this document. The detailed descriptions of the NRTS first-order waste generators and waste handling practices are provided in Volume II. (auth)

7456 (WASH-1269) TRITIUM CONTROL TECHNOLOGY. Rhinehammer, T. B.; Lamberger, P. H. (comps.). (Mound Lab., Miamisburg, Ohio (USA)). Dec 1973. Contract AT(33-1)-Gen-53. 539p. Dep. NTIS $13.60.

A separate abstract was prepared for each of the 12 sections contained in the report. (TFD)

For abstracts of individual sections see: 6468, 7457–7462, 7468, 7469, and 8795–8797.

7457 (WASH-1269, pp 245-272) LABORATORY AND PROCESS FACILITIES: PACKAGING, STORAGE, AND DISPOSAL. Dec 1973.

In tritium control technology.

Packaging, storage, and disposal of tritium at various AEC and private installations are described. (TFD)

7458 (WASH-1269, pp 337-347) GOVERNMENT REACTORS: PACKAGING, STORAGE, AND DISPOSAL. Dec 1973.

In tritium control technology.

Packaging, storage, and disposal of tritium at government-owned reactors are described. (TFD)

7459 (WASH-1269, pp 349-380) COMMERCIAL POWER REACTORS. Dec 1973.

In tritium control technology.

Tritium control at commercial power reactors is described. (TFD)

7460 (WASH-1269, pp 381-425) FUEL REPROCESSING PLANTS. Dec 1973.

In tritium control technology.

Tritium control at fuel reprocessing plants is described. (TFD)

7461 (WASH-1269, pp 427-461) WASTE DISPOSAL FACILITIES. Dec 1973.

In tritium control technology.

Disposal of tritium wastes at various facilities is reviewed. Some proposed methods for disposal are also discussed. (TFD)

7462 (WASH-1269, pp 463-530) ANNOTATED BIBLIOGRAPHY. Dec 1973.

In tritium control technology.

One hundred ninety-eight references to literature on handling, containment, trapping, removal, concentration, packaging, storage, disposal, assaying, and monitoring of tritium are presented. (TFD)

7463 NEW APPROACH TO TRITIUM LEAK RATE DETERMINATION. Sheehan, W. E.; Curtis, M. L. (Monsanto Research Corp., Miamisburg, OH). Contract AT(33-1)-Gen-53. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 522-525(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A method for determining leak rates (on the order of 1×10^{-11} cm^3/sec and higher) from containers of tritium waste is described. Each container is sealed in a disposable can. After several days, the accumulated tritium is flushed from the can with compressed air through an ethylene-glycol bubbler where the HTO, but not the HT, is trapped. The output of the bubbler is channeled through a heated palladium catalyst where the HT is oxidized. The oxidized HT is collected in a second ethylene-glycol bubbler. The tritium collected in both bubblers is measured by liquid scintillation counting. (auth)

7464 MANAGEMENT OF SOLID RADIOACTIVE WASTES. Kluk, A. F.; Wong, D. T. (Atomic Energy Commission, Washington, DC). Chem. Eng. Progr.; 70: No. 4, 85-86(Apr 1974).

Complete manuscript (MS No. 5382) available from American Institute of Chemical Engineers, New York for $5.00.

The US AEC solid radioactive waste program was developed to assure the continued safe management of solid radioactive waste generated in the development and use of nuclear technology. Recent improvements in the management of radioactive solid wastes are discussed with information included on current waste handling practices, waste treatment, burial ground stabilization programs, pilot experiences, and waste management costs. These improvements should help the expanding nuclear industry to safely manage its radioactive wastes. (LCL)

7465 MANAGEMENT OF RADIOACTIVE WASTES IN THE USA AND IN THE AEC-INDUSTRY DIVERGENCIES. Com. Naz. Energ. Nucl., Notiz.; 20: No. 2, 47-49(Feb 1974). (In Italian).

Information on the measures taken in the U. S. for the disposal of radioactive wastes and on the various facilities in the planning or design stages, such as the Retrievable Surface Storage Facility (RSSF), a pilot facility in salt strata, etc., is presented. Mention is also made of the arguments and divergencies that have arisen between the AEC and the industries on the management of radioactive wastes. The Midwest Fuel Recovery Plant (MFRP) which General Electric has built at Morris, Ill. near the Dresden Plant is also discussed. (auth)

Handling Equipment and Procedures

7466 (CONF-740523-1) CONTAINMENT OF ^{233}U IN THE PROCESSING FACILITIES OF THE ORNL PILOT PLANT. Brooksbank, R. E.; Parrott, J. R.; Youngblood, E. L.; McDuffee, W. T. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 20p. Dep. NTIS $4.00.

From seventh international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The ORNL Pilot Plant has been engaged in the handling and processing of ^{233}U for 15 y. The various operations utilized for storage, purification, and conversion to oxide are outlined. Methods of containment used with vessels, remote processing cells, glove-box fabrication systems, and plant effluent systems are emphasized. The surveillance experience gained during the operational period is summarized. (auth)

7467 (ORNL-TM-4583) HIGH-PRESSURE ION-EXCHANGE COLUMN DESIGN FOR REMOTE HOT-CELL OPERATION. Brown, L. C.; Callahan, A. P. (Oak Ridge National Lab., Tenn.

(USA)). May 1974. Contract W-7405-eng-26. 13p. Dep. NTIS $4.00.

The separation and purification of adjacent rare-earth elements is a frequently encountered problem in the course of radionuclide development. High-pressure ion-exchange (HPIE) elution chromatography, utilizing micron-size cation-exchange resin beads, has been used widely for the rapid, efficient separation of small samples of these chemically similar elements. Radionuclide production operations, on the other hand, often yield highly radioactive rare-earth samples of a few tenths of a gram to a few grams in size that must be separated and purified by remote handling procedures in shielded hot cells. An earlier single-cycle chromatograph apparatus, a heated resin column connected directly to a high-pressure pump and pressure gauge, was satisfactory for small-scale, bench-top operation where the apparatus could be readily disassembled after each run for resin replacement, but this design required that the column charge and elution solutions be pumped through the pump and past the pressure gauge dead leg which resulted in excessive tailing and poor separation efficiency. When this earlier design chromatograph apparatus was used for more than one or two separations without repacking or replacing the resin, the resin column would pack down so tightly that the column back pressure would exceed the working limits of the pump with resultant pump damage. In order to overcome these difficulties and to accommodate the larger production samples with remote handling requirements, a versatile, compact HPIE column design has been developed. This column allows resin loading and repacking, sample loading, elution, and maintenance to be performed remotely with minimum effort and cross-contamination. To date this new column design has been used for more than 50 rare-earth separations with no equipment failures or sample cross-contamination. The equipment was designed so that more than one operation could be performed simultaneously, enabling completion of the sample loading, elution, resin reconditioning, and column repacking cycles within an eight-hour period. (auth)

7468 (WASH-1269, pp 3-87) LABORATORY AND PROCESS FACILITIES: MONITORING. Dec 1973.

In tritium control technology.

Monitoring and control of tritium at various AEC and private facilities are described. (TFD)

7469 (WASH-1269, pp 89-198) LABORATORY AND PROCESS FACILITIES: HANDLING AND CONTAINMENT. Dec 1973.

In tritium control technology.

Handling and containment of tritium at various AEC and private installations are described. (TFD)

7470 ORGANIZATSIYA RABOTY S RADIOAKTIVNYMI VESHCHESTVAMI V LECHEBNYKH UCHREZHDENIYAKH. Organization of Work with Radioactive Materials in Medical Establishments). Kogut, T. S.; Lizogub, N. P. Kiev; Zdorv'ya (1973). 203p.

Problems of rational organization of work of medical personnel in the use of open and sealed radioisotopic sources are clarified. The physical and chemical properties of radioisotopes used for medical purposes and radiation protection of workers with these sources are reviewed briefly. Specific recommendations are made on the organization of protection of medical personnel in radiology departments. Special attention is given to radiometric and dosimetric control and of medical observations on persons working with radioactive substances and sources of ionizing radiation. The book is designed for doctors, radiologists, persons working with dose rates, specialists in radiation hygiene, radiological laboratory workers, and rural and city clinic commissions. (~60 references). (tr-auth)

7471 SAFE HANDLING OF RADIOISOTOPES. Farran, H. E. A. (Northwith Park Hospital, Harrow, Eng.). Ann. Rheum. Dis.; 32: No. 6, Suppl., 17-18(Dec 1973).

From symposium on radioactive colloids in the treatment of arthritis; Harrow, Eng. (6 Jul 1973).

In order to administer radioactive isotopes to humans it is necessary to acquire two pieces of paper. The first, which is essential, is a license to store and dispose of radioisotopes which is issued by the Department of the Environment. The second, which is advisable, is the authority of the M. R. C. Advisory Panel on the Use of Radioactive Isotopes in Humans. The M. R. C. is primarily concerned with the risk to the patient while the Department of the Environment is primarily concerned with pollution. There are certain basic rules for the safe handling of isotopes that apply under all circumstances and are the result of a combination of common sense and good housekeeping. These include: the collection of all radioactively contaminated glassware etc. for monitoring and subsequent storage until the natural decay of the isotope enables them to be disposed of, adequate and meticulous labeling of all solutions, no pipetting of radioactive solutions by mouth, etc. The most effective form of protection is adequate training. Supervision by a radiation safety officer is compulsory. A safe syringe filling routine is given. (UK)

Transportation

Refer also to abstract 6193.

PARTICLE ACCELERATORS

Design, Development, and Operation

7472 (GSI-73-10) INVESTIGATIONS FOR THE DESIGN OF A HEAVY ION LINEAR ACCELERATOR OF THE WIDEROEE-TYPE. Design of the Four Wideroee Sections of the UNILAC Accelerator. Kaspar, K. (Gesellschaft fuer Schwerionenforschung m. b. H., Darmstadt (F. R. Germany)). Oct 1973. 164p. (In German). INIS.

The prestripper section of the UNILAC accelerator is intended to be used for the acceleration of heavy ions of uranium up to an 11-fold positive charge with an energy of 0.011 to 1.41 MeV/nucleon. It is comprised of four tanks of the type of the Wideroee accelerator, arranged in series. The various basic concepts, the methods, and measuring results underlying the design of the four Wideroee tanks are discussed in detail. (INIS)

7473 (LA-5518-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending October 31, 1973. Dunn, E. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 52p. Dep. NTIS $5.45.

Progress continues on the operation of the experimental area beams. Tuning of the channels is being accomplished in good order, and construction, development, and improvement of beam transport and diagnostic hardware for Lines A, B, and X continues. The accelerator was operated a total of 172 eight-hour shifts, with beam available 75% of the time. (auth)

7474 (LA-5580-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending January 31, 1974. Dunn, E. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 49p. Dep. NTIS $5.45.

Activities in completing the development of the experimental areas have kept pace with the schedule. Four beam lines are now operational--the neutron line in Area B, and the Low-Energy Pion, High-Energy Pion, and Stopped Muon Channels in Area A. Tuning on these channels will be completed next quarter. The maintenance effort has continued with a major aim being to improve the reliability, stability, and reproducibility of accelerator operation. The accelerator was in operation for 44 eight-hour shifts in November and 26 shifts during the latter part of January; the operating time during this report period was 410 h. During the shutdown period, beam transport and the vacuum line were installed in Area A-East all the way to the beam stop. (auth)

7475 (NIIEFA-A-173) CONSTRUCTION VARIANTS OF A LINEAR INDUCTION ACCELERATOR. Vakhrushin, Yu. P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 23p. (In Russian). INIS.

Expressions are derived for the scattering inductance and capacitance of the principal construction variants of an induction system. The equivalent load resistance on the front of the accelerating voltage pulse is determined. On the basis of these expressions and a simplified equivalent circuit of the accelerating system, equations are derived for the duration of the voltage pulse front. An analysis is given of the main construction variants of the induction system from the point of view of a minimum front duration. It is concluded that it is necessary that there be a correspondence between the construction variant and the magnitude of the equivalent load. (tr-auth)

7476 (SLA-74-5024) TWO NEW COLLECTIVE ACCELERATION SCHEMES. Olson, C. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 18p. (CONF-740522-6). Dep. NTIS $4.00.

From ninth international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

Two new methods of collective ion acceleration are given. Both utilize an intense relativistic electron beam to create an accelerating field and a focusing field. Both should permit the realization of a compact, relatively inexpensive, high-energy ion accelerator. It is emphasized that accelerating fields of order of 10^8 V/cm have already been demonstrated experimentally. In addition, existing intense beams have the power and pulse lengths required to accelerate protons to GeV energies and heavy ions to energies above 10 A MeV for $\zeta/A \geq 0.1$. Even higher ion energies appear possible, using state of the art intense beam technology or future technology. (39 references) (auth)

7477 (SLA-74-5035) COLLECTIVE ION ACCELERATION IN LINEAR ELECTRON BEAMS. Swain, D. W.; Kuswa, G. W.; Poukey, J. W.; Olson, C. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 14p. (CONF-740522-10). Dep. NTIS $4.00.

From ninth international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

Collective acceleration of ions by intense relativistic electron beams injected into low-pressure neutral gases has been observed. The acceleration mechanism is studied for a guide tube filled with a vacuum, a neutral gas with uniform pressure, and a neutral gas with a pressure gradient (both positive and negative gradients are considered). A unique feature of these experiments is that time-resolved energy measurements of the ions were made. The results are explained in relation to the Olson theory, and numerical simulation results are given which confirm this explanation. In all cases, ion acceleration occurs in the electric fields of a time-dependent, 2D, electrostatic, potential well. (auth)

7478 (UCID-16487) EXPERIMENTS ON THE AUTOACCELERATION OF A RELATIVISTIC HIGH CURRENT ELECTRON BEAM. Fessenden, T. J.; Briggs, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Apr 1974. Contract W-7405-eng-48. 21p. Dep. NTIS $4.25.

Results of a brief experimental test of an electron autoaccelerator structure are described. These preliminary experiments studied the interaction of an intense relativistic beam with a simple multicavity structure. The main goal of the experiment was to determine the characteristics of the r.f. fields excited by the beam, and to see if the longitudinal r.f. electric fields would result in autoacceleration of some beam particles. Control of the r.f. modes is a central issue in any of the autoacceleration schemes that have been proposed, since one may wish to enhance their excitation in a self-excited r.f. acceleration mode, or suppress them to allow "adiabatic" ($E_z \sim -\dot{I}$) inductive acceleration of particles at the pulse tail to dominate. In the experiment, the transverse beam breakup mode was observed and suppressed by alterations in the cavity walls. The longitudinal modes were then dominant and strong modifications in the particle energy distributions were observed. (auth)

7479 RADIATION PROTECTION CONSIDERATIONS ON THE DESIGN AND OPERATION OF PARTICLE ACCELERATORS. Pettersson, B. G. (comp.). Paris: Organisation for Economic Cooperation and Development (1974). 50p.

The document is mainly intended as a guide for national authorities responsible for drawing up radiation protection rules and regulations for particle accelerators. The document may also be of help to those responsible for the design and operation of a particle accelerator laboratory inasmuch as it will provide information on relevant international radiation protection recommendations. The document is a compilation largely based on the U. S. Safety Standards contained in NBS Handbook 107 on "Radiological Safety in the Design and Operation of Particle Accelerators," and on relevant paragraphs in the ICRP publications 5, 9, 12, 15 and 21. Certain paragraphs are taken from the International Commission on Radiation Units and Measurements (ICRU) Report 20. The main object has been to use the full original text of the extracts (subject in some cases only to minor modifications, mostly of an editorial nature), rather than to rephrase and reedit the extracts. The document considers, from the health physics point of view, the characteristics of the controls for ionizing radiation produced in particle accelerators insofar as they affect their design, operating procedures, exposure evaluation and dose limitation. Although design and operational requirements are closely interconnected elements of safety, they are dealt with separately in order to distinguish between the specific information needed when the concern is, on the one hand, the design and manufacture and, on the other, the operation of a particle accelerator. Problems related to the protection of the patient where accelerators are used for medical purposes are not dealt with here. The guidelines contained in the document apply mainly to particle accelerators with energies less than 50 MeV, but the criteria laid down may be adopted whenever appropriate for accelerators of higher energies. The document deals only with accelerators where the particles constitute the useful beam; it does not deal with x-ray machines. Also, problems specifically related to neutron accelerators are not considered. (WHK)

7480 IONIZING RADIATION PROTECTION PROBLEMS ASSOCIATED WITH HIGH ENERGY RADIOTHERAPY ELECTRON LINEAR ACCELERATORS. Huber, H. (Thomson, CSF, Paris). pp 307-320 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The two basic problems of health physics are discussed: protection of patients, and protection of nonpatients (persons directly and indirectly concerned with ionizing radiations, and the general public). The most important features of high-energy electron linear accelerators are discussed together with their parasitic radiation sources and the properties of such radiations. The shielding of the equipment is examined. The constructor and the persons installing the equipment share the responsibility in this domain. The measures taken to ensure the safe operation of two French linear accelerators are described, i.e., SAGITTAIRE (operating between 7 and 40 MeV) and NEPTUNE (operating at 6 MeV). (FR)

7481 EUROPE'S BIGGEST ACCELERATOR. Southworth, B. (European Organization for Nuclear Research, Geneva). Phys. Bull. (London); 25: 136-137(Apr 1974).

The construction of Europe's largest accelerator, the super proton synchrotron, is described. This accelerator will ensure that CERN continues to provide frontline research facilities to over 1000 high energy physicists from universities and research centers throughout Europe. Virtually all of the design decisions have been made. Civil engineering work is well advanced and accelerator components are arriving at the CERN site for assembly and testing. Detailed preparations for the experimental program have already started. Experimentation at energies in the hundreds of GeV range requires large, sophisticated detector systems, and building must be started soon if they are to be ready for the scheduled start of the experimental program. It is planned to provide high-energy beams in the west area by the end of 1976 and in the north area by early 1978. (UK)

7482 REGIMES OF ELECTRON BEAM AUTOACCELERATION. Belov, N. E.; Kisletsov, A. V.; Lebedev, A. N. At. Energ. (USSR); 36: No. 3, 201-206(Mar 1974). (In Russian).

Parameters of a cylindrical cavity are optimized from the standpoint of autoacceleration of an intense electron beam. For the case of a beam passing through a cavity, total energy losses are calculated as a function of beam and cavity parameters. A self-consistent autoacceleration process is investigated numerically for the simplest system represented by a chain of independent cavities. (auth)

7483 SIMPLIFIED CALCULATION OF THE LONGITUDINAL DIMENSIONS OF A LINEAR PROTON ACCELERATOR. Vlasov, A. D. Tr. Radiotekh. Inst.; No. 9, 90-95(1972). (In Russian).

A simplified method is presented for calculating the longitudinal dimensions and equilibrium motion in a linear proton accelerator with drift tubes. It is shown that with ordinary accelerator parameters the simplified calculation leads to errors in the equilibrium velocity and equilibrium phase not exceeding 0.3% and 22' respectively at the beginning of the accelerating, and these errors decrease with acceleration. These errors have no effect on accelerator operation. By use of the simplified method of calculation it is possible to avoid methods of calculation based on successive approximations which are ordinarily complex and cumbersome. (tr-auth)

7484 NONRELATIVISTIC ELECTRON RING ACCELERATOR. Bobrowski, C.; Suszycki, L. (Instytut Nowych Konweraji Energii, Krakow). Arch. Elektrotech. (Warsaw); 23: No. 1, 15-23(1974). (In Polish).

A possible design of an electron ring accelerator in the nonrelativistic energy range is considered. The theoretical basis of the acceleration and, also, some technical problems are discussed. (auth)

7485 ESTIMATION OF DIMENSIONAL-WEIGHT AND ENERGY CHARACTERISTICS OF ELECTRON ACCELERATORS FOR EXPERIMENTAL AND INDUSTRIAL RADIATION INSTALLATIONS. Karmaza, V. S.; Malyshev, I. F.; Prudnikov, I. A. Sov. J. At. Energy (Engl. Transl.); 34: No. 1, 48(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 37(Jan 1973).

A recommended procedure for choosing accelerators for industrial applications is presented. Graphs are presented of the characteristics of electrostatic and cascade generators, resonance transformers, and linear accelerators. (WHK)

7486 FUTURE STATUS OF ACCELERATORS FOR INDUSTRY. Tanaka, J. (National Lab. for High Energy Physics, Oho, Japan). Genshiryoku Kogyo; 19: No. 5, 35-39(May 1973). (In Japanese).

The different types of accelerators are briefly reviewed. It is pointed out that only the electrostatic-type accelerators and electron linear accelerators can deliver enough beam power to be useful for industrial applications. (WHK)

7487 REVIEW OF THE LARGE NEW ACCELERATORS OF HEAVY IONS. Odera, M. (Inst. of Physical and Chemical Research, Wako, Japan); Hirao, Y. Nippon Genshiryoku Gakkaishi; 16: No. 1, 34-42(Jan 1974). (In Japanese).

A review of large-scale new heavy ion accelerators is given. It is intended for discussion of an accelerator of heavy ions as a national project in Japan. Requirements which the machine should fulfill are defined and several types of accelerators are presented together with their characteristics and examples. Brief comments on possibilities of new techniques are also given. (auth)

Auxiliaries and Components

7488 (DESY-74-12) NEW APPROACH TO EVALUATE SPUTTER-ION PUMP CHARACTERISTICS. Hartwig, H.; Kouptsidis, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Apr. 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

By using theoretical considerations combined with experimental results a general approach to the evaluation of sputter-ion pump characteristics is given. This approach can be successfully applied to optimal design of distributed sputter-ion pumps in high-energy accelerators. The agreement between proposed and measured pumping speed values is better than 30%. (auth)

7489 (JINR/P9-7773) SOME PECULIARITIES OF OPERATION OF CURRENT COMMUTATOR ON INDUCTIVE LOAD. Barabash, L. S.; Miskii, S. M.; Timokhin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Results of investigations on thyristors, used for forming pulsed magnetic fields, are presented. The peculiarities of the schemes with the inductive load which use a series connection of thyristors and diodes are described. (auth)

7490 TUNGSTEN PIN CUSHION PHOTON BEAM MONITOR. Miller, G. (Univ. of Washington, Seattle); Walz, D. R. Nucl. Instrum. Methods; 117: No. 1, 33-37(1974).

A simple high-energy photon beam monitor that produces a large signal comparable to that from a secondary emission quantameter was constructed. The device is a four-quadrant beam position monitor that was used to precisely center a coherent bremsstrahlung beam on a small aperture collimator at the Stanford Linear Accelerator Center (SLAC). Each quadrant consists of an array of closely-spaced tungsten needles pointing in the downbeam direction from a tungsten base plate. This tungsten "pin-cushion" was mounted in air with no biasing potential. High-energy photons produced a positive charge on the pincushion by the shower emission effect. (auth)

7491 STUDY OF THE PHASE WIDTH CONTROL FOR THE HAMBURG ISOCHRONOUS CYCLOTRON WITH A CONTROL ELECTRODE BIAS IN THE ION SOURCE OUTLET. Krause, H.; Langkau, R. (Univ., Hamburg). Nucl. Instrum. Methods; 117: No. 1, 29-32(1974). (In German).

The possibility of controlling the phase width and the time structure of a cyclotron beam by an ion-source bias has been studied. (auth)

7492 OPERATIONAL ASPECTS OF A SERIAL CAMAC CONTROL SYSTEM. Barsotti, E. J.; Lau, H. C.; Simanton, J. R. (National Accelerator Lab., Batavia, IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 881-885(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A serial control system was dictated for the Meson, Neutrino, and Proton experimental beam lines at NAL. Because ten to fifteen experiments can be running at the same time in any of the three areas, the operating system was programmed to have the capability of servicing several remote consoles simultaneously. Input and output block transfer capabilities allow the control system to handle large blocks of data to or from experimenters and other parts of the accelerator and beam lines while minimizing computer CPU and serial link time. The CAMAC control system hardware is briefly described. (WHK)

7493 BEAM CURRENT INTEGRATOR FOR RADIOACTIVITY CROSS SECTION DETERMINATIONS. Birch, D. T.; Nelson, J. W. (Florida State Univ., Tallahassee). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 822-825(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A specialized beam current integrator has been built for use in measuring cross sections for reactions which lead to radioactive products with half-lives in the millisecond to hour range. The principle of operation, NIM module construction and typical example of results are described. (auth)

7494 DIGITAL MONITORING SYSTEM FOR NAL SECONDARY BEAM LINES. Martin, R. G. (National Accelerator Lab., Batavia, IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 925-927(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A digital beam monitoring system (BELIMOS) consisting of high spatial and time resolution multiwire proportional chambers and associated amplifier circuitry, and a CAMAC data acquisition system has been used to provide readout and display of beam profile and position information of the NAL secondary beam lines. (auth)

7495 GENERATOR OF SYNCHRONIZING PULSES AT LOW RATES OF MAGNETIC INTENSITY CHANGE IN SYNCHROTRON ELECTROMAGNET. Narinyan, V. T.; Tumanyan, A. R. (Erevan Physics Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 4, 279-282(1973). (In Russian).

A device for formation of pulses corresponding to definite instantaneous values of magnetic field intensity when the rate of intensity change lies in the range 0 to $2 \cdot 10^4$ oersted/sec. is described. The device consists of three Permalloy probes, an rf current generator, a pulse former, and a coincidence unit. (auth)

7496 SHIELDING FROM MU-MESONS IN RING PROTON ACCELERATORS. Serov, A. Ya.; Sychev, B. S. Tr. Radiotekh. Inst.; No. 9, 127-135(1972). (In Russian).

Calculations were made on the flux distribution of μ-mesons in the primary shielding of proton synchrotrons. It is shown that the flux of μ-meson in the secondary shielding may substantially exceed the high-energy neutron flux. With decreasing accelerator radius the flux of μ-mesons in the shielding increases. (tr-auth)

7497 ELECTRIC STRENGTH OF A LARGE ACCELERATING GAP. Polyakov, B. I.; Uksusov, N. I.; Zaidin, D. G.; Kushin, V. V. Tr. Radiotekh. Inst.; No. 9, 84-89(1972). (In Russian).

An experiment is described on the testing of the electric strength of a large accelerating gap at a frequency of 150 Mhz. Sparking in the nonconditioned gap of 210 mm length occurred at a field amplitude of about 4 M volts. A diagram and description are presented on details of the experimental test unit developed during design of the Serpukhov accelerator-injector I-100 with a length of the accelerating gap in the average resonator up to 200 mm. (tr-auth)

7498 CALCULATING THE EFFECT OF MANUFACTURING ERRORS ON THE CHARACTERISTICS OF THE ACCELERATING STRUCTURE. Pirozhenko, V. M. Tr. Radiotekh. Inst.; No. 9, 44-54(1972). (In Russian).

A method is described, and results are presented for calculating the effect of random manufacturing errors on the amplitude distribution of the accelerating field and the high-frequency losses in resonators which consist of a large number of connecting cells and which are excited on the F/2-wave. As an example a determination is made of the effect of manufacturing errors on the characteristics of accelerator resonators of a "meson factory." (tr-auth)

7499 EXCITATION OF RESONATORS OF HIGH-FREQUENCY ACCELERATORS WITH LOADING BY A BEAM OF CHARGED PARTICLES BEING TAKEN INTO ACCOUNT. Lomize, L. G.; Filipchikov, L. L. Tr. Radiotekh. Inst.; No. 9, 55-65(1972). (In Russian).

It is shown that the problem of exciting a resonator by an accelerated beam at a definite type of oscillation can be reduced to the problem of exciting a parallel LCR-loop with an equivalent current, whereupon the elements of the equivalent loop and the equivalent current are unequivocably determined by parameters of the resonator, by the type of oscillation under consideration, and by the actual flux of accelerated particles. The general relations connecting the actual and equivalent parameters of the volume resonator have been calculated for the case of a typical resonator of a linear proton accelerator with an accelerating Alvarez structure. (tr-auth)

7500 PARAMETERS OF THE ACCELERATING STRUCTURE FOR A LINEAR HIGH-ENERGY PROTON ACCELERATOR. Andreev, V. G.; Pirozhenko, V. M. Tr. Radiotekh. Inst.; No. 9, 36-43(1972). (In Russian).

Results are presented on the numerical calculation of the geometrical form and radiotechnical parameters of the accelerating structure for a linear proton accelerator at energies above 100 to 150 MeV in the form of a volume resonator with disks and diaphragms, in which the sign-changing electrical field is excited on the axis in the mode of a F/2-wave. Experimental data are also given on the dispersion dependence, the binding coefficient and the sensitivity of the accelerating field to errors in preparing the structure. (SJR)

7501 SPECIAL DISPLAY FOR AN IONIZATION PROFILOMETER. Elin, V. V.; Mamaev, G. L. Tr. Radiotekh. Inst.; No. 9, 109-116(1972). (In Russian).

The display is intended for selection, recording and visual presentation of information from an ionization profilometer of a ring accelerator of IHEP. Information on both projections enters in analogue form from a television system, and is converted to a form suitable for processing. The display is created on a base of a two-beam storage oscillograph of the type CI-42. (SJR)

7502 IONIZATION PROFILOMETER OF THE SERPUKHOV RING ACCELERATOR. Kuz'min, A. A.; Elyan, V. V.; Mamaev, G. L.; Tot'ev, Yu. K. Tr. Radiotekh. Inst.; No. 9, 101-108(1972). (In Russian).

A profilometer is described that is intended to study the structure of a proton beam to be accelerated in the ring accelerator of IHEP without destruction of the beam. The principles of construction of the profilometer and the results of tests on an equipment model are given. (SJR)

7503 PRACTICAL APPLICATIONS OF (p,γ) REACTIONS. Vakselj, M. (Univ. of Ljubljana, Yugoslavia). pp 367-381 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

Radiative proton capture has played an important role as a tool for the investigation of the properties of the excited levels of light and medium-heavy nuclei. In addition to its importance for investigating the properties of excited levels, the (p,γ) reaction, because of resonant capture, can be used as a powerful tool for solving several other nuclear or even nonnuclear problems. Some unusual applications of (p,γ) reactions, where the narrowness of the resonances in radiative proton capture is exploited, are discussed. (6 figures, 1 table) (auth)

7504 DESIGN, CONSTRUCTION, AND PERFORMANCE OF A GENERATING VOLTMETER FOR A 400-kV VAN DE GRAAFF GENERATOR. Rajapandiyan, S.; Prabhakar, B. R. (Indian Inst. of Science, Bangalore). J. Inst. Eng. (India), Elec. Eng. Div.; 52: No. 2, 1-5(Oct 1971).

The details of a 400-kV generating voltmeter designed and constructed in the Indian Institute of Science, Bangalore are presented. The principle of operation is described and the performance of the voltmeter under different conditions was studied. The effects of blade shape, speed of motor and the distance of the voltmeter from the generator on the magnitude and shape of the output signal are examined. The effect of corona on the waveform of the signal is discussed. Report of an investigation on how the metal and insulator columns behave is presented. (auth)

Ion Sources and Injection and Extraction Systems

7505 (BARC/I-120) PREINJECTION e/m ANALYZER SYSTEM FOR USE WITH VAN DE GRAAF ION SOURCES. Misra, S. M.; Dwarkanath, M. R. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 40p. INIS.

R.F. ion sources used in the Van de Graaff accelerators, at the Bhabha Atomic Research Centre, India, produce ions in different charge states. These ions acquire different energies in falling through the same potential difference. There are different methods of separating the ions. A device which allows such separation and selective injection of the required type of ions into the accelerator is described. It is primarily designed for the acceleration of He^{++} ions. It employs an Einzel lens to prefocus the divergent beam from the ion source and crossed electric and magnetic fields to separate ions with different e/m. A schematic diagram of the device is also presented. The magnetic field is fixed and scanning of the beam is done by varying the electric field. The theory on which the calculation of the aperture size, resolving power, etc. are based, is briefly outlined. The complete system has been fully bench-tested. It has adequate resolution and gives a He^{++} ion yield of 1.5 microamperes. (INIS)

7506 (BNL-18829) WILL NEGATIVE HYDROGEN ION SOURCES SOON REPLACE PROTON SOURCES IN HIGH ENERGY ACCELERATORS? Sluyters, T.; Prelec, K. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 1p. (CONF-740522-9). Dep. NTIS $4.00.

From ninth international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

New developments in negative hydrogen ion sources are briefly reviewed, and the possibility of using them for injection into circular accelerators for proton acceleration is discussed. Two new approaches to the production of negative hydrogen ion beams include the hollow discharge duoplasmatron and the racetrack magnetron. Prototypes of both of these types have been built at BNL, and results of experiments with them are outlined. (WHK)

7507 (BNL-18831) BNL FAST SHAVING EXTRACTION SYSTEM. Blumberg, L.; Bagley, G.; Bennett, G. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 5p. (CONF-740522-12). Dep. NTIS $4.00.

From ninth international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

Design and performance of a recently commissioned fast extraction system to serve the requirements of the bubble chamber programs at the AGS are discussed. Several of the major components are described along with the diagnostic instrumentation and system performance. Extraction of various fractions of the internal beam, including total extraction in an essentially single-turn mode, has been accomplished with the AGS beam either bunched or debunched. The expected extraction efficiency, ~95%, has been observed and transport losses in the 258 m, 10-cm aperture external beam are ≤ 1%. (auth)

7508 (GSI-73-8) GSI-WORKSHOP ON ION SOURCES. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). Jul 1973. 54p. (In German).

Five individual lectures on the state of development of several types of ion sources are presented. Some sources of heavy and multiple charged ions are described (EBIS, MPIG, Penning, and duoplasmatron sources) which are intended for use in the UNILAC. (GE)

7509 (JINR-P9-7836) POSSIBLE WAYS OF INCREASING THE BEAM DURATION IN A SYNCHROCYCLOTRON. Onishchenko, L. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 30p. (In Russian). Dep NTIS (US Sales Only) $4.50.

Possible ways of increasing the duration of the inner and extracted beams of synchrocyclotrons are considered. (auth)

7510 OPTICALLY-COUPLED SERIAL CAMAC SYSTEM. Heywood, D. R.; Ozzard, B. (TRIUMF, Vancouver, British Columbia). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 889-891 (Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

An optically-coupled serial system that transmits CAMAC messages between a crate at ground potential and two crates at -300 kV in an ion source cage at the TRIUMF cyclotron is described. CNAF + DATA messages are parallel-loaded into the ground station from the Dataway, pass serially through a fibre-optic link and emerge from the high potential station in parallel branch highway format. Returning STATUS + DATA messages pass serially through a second fibre-optic link to the ground station where they are stored in parallel registers to be read onto the Dataway. Completion of the 80 μsec cycle is signalled by a LAM. (auth)

7511 MEDIAN PLANE INJECTION IN THE DELFT ISOCHRONOUS CYCLOTRON. van Kampen, W. A. (Delft Univ. of Tech., Netherlands). Delft Progr. Rep., Ser. B; 1: No. 1, 5-8 (Dec 1973).

External injection of particles into an isochronous cyclotron using the precession mode of particle motion along a hill-valley boundary is being tried in the Delft 12 MeV isochronous cyclotron. A progress report is given, describing the experimental set-up and the numerical approach to solve this kind of injection problem. (auth)

Ion Optics and Field Calculations

7512 (BARC/I-258) ROTATION OF THE PHASE-SPACE ELLIPSE IN A BEAM TRANSPORT SYSTEM. Bhattacharya, N. C. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

When a beam of charged particles is transported through a series of magnetic elements and drift spaces, the phase-space ellipse goes on rotating around a given axis. A method is presented to compute the rotation of the radial phase-space ellipse at any point along a beam transport system. Furthermore, it is shown, how from the angle of rotation of the phase-space ellipse, one can locate the position of the radial waist and bust. (auth)

7513 (BNL-18819) RESONANCE CROSSING IN A PROTON SYNCHROTRON; APPLICATION TO ISABELLE. Chasman, R.; Garren, A.; Gluckstern, R. L.; Mills, F. E. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 6p. (CONF-740522-2). Dep. NTIS $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The effect on the transverse properties of a beam in the presence of a nearby nonlinear resonance, periodic variation of the betatron tune as a result of synchrotron oscillations leading to periodic resonance crossing, and a zeroth harmonic octupole term (or other multipole) which makes the betatron frequency depend on transverse amplitude is studied. Depending on whether the product of the resonance strength and the zeroth harmonic octupole component is small or large, one gets one of the following two pictures for fast resonance crossing: a) A pattern of resonances and side bands, the side bands being separated by ν_s/n (ν_s is the synchrotron frequency, n the order of the resonance). Detailed consideration of the betatron phase change between consecutive crossings leads to prediction of an odd-even dependence of the beam growth on the side band number. Computer runs yield phase-space trajectories which confirm these predictions in detail. b) A diffusion-like process, the betatron tune shift between crossings resulting from the amplitude change now being larger than the spacing of side bands. The diffusion picture also holds whenever ν_s/n is smaller than the betatron tune stability. These effects are observed in computer runs and lead to design tolerances for the resonance terms. When nonlinearities are present that are larger than these tolerances, azimuthally distributed multipoles have to be introduced to tune out the resonances. The multipole distributions required to do so have been calculated. (auth)

7514 (BNL-18822) EFFECT OF THE BEAM SELF-FIELD ON THE TRANSVERSE BETATRON OSCILLATION FREQUENCY. Parzen, G.; Jellett, K. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 5p. (CONF-740522-7). Dep. NTIS $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The electric and magnetic fields generated by the accelerator beam are computed using a mesh-iteration program. This allows the self-fields to be computed for beams having any desired charge or current distribution, and for vacuum chambers and magnet pole faces of any desired shape. The shift of the transverse betatron oscillation frequencies due to the self-fields of the beam can then be computed. The results are applied to various beam geometries including ISABELLE, the AGS, and a small aperture conventional storage accelerator. Comparisons are made with the results found using the analytical results for simple geometries. (auth)

7515 (JINR-P9-7786) SCREENING OF QUASISTATIONARY MAGNETIC FIELDS BY THIN METALLIC PLATES. Aleksakhin, Yu. I.; Kazarinov, N. Yu.; Perel'shtein, E. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 26p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

A new method is presented for calculation of quasistationary magnetic fields inside thin metallic chambers used in accelerator, plasma, and other installations. The values of the magnetic field for chambers of arbitrary geometry are found sufficiently accurately and quickly using computers. (auth)

7516 (UCID-16490) ENVELOPE EQUATION OF A CHARGED PARTICLE BEAM. Lee, E. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1974. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

An equation is derived for the time dependent r.m.s. radius of a low current beam; the effects of scattering, energy change, self-focusing and external focusing are included. All well known cases of propagation are recovered (Nordstëck equation, free particle scattering, sausage equation, and vacuum transport). In addition, a foundation is laid for new applications not covered by these special limits. (auth)

7517 PROBLEM OF ADDITIONAL DAMPENING DURING SMOOTHING OUT OF EQUATIONS IN FINITE DIFFERENCES. Zaidin, D. G. Tr. Radiotekh. Inst.; No. 9, 96-100(1972). (In Russian).

A method is described for going from equations in finite differences to smoothed differential equations by which it is possible to avoid the appearance of additional dampening in the conservative case. (tr-auth)

7518 USE OF ASYMMETRIC, PHASE-CHANGING FOCUSING IN A LINEAR ACCELERATOR. Kushin, V. V. Tr. Radiotekh. Inst.; No. 9, 23-35(1972). (In Russian).

Relations are presented for determining the parameters of

regions of phase and radial capture of an accelerator with asymmetrical phase-changing focusing. Operating modes are found that assure optimal capture and acceleration of protons in the range of energies up to 150 to 200 MeV. Calculated data are presented for two variants of the accelerator at energies from 200 keV to 100 MeV with accelerated proton currents of 35 milliamps. Results are presented for numerical modeling of proton motion in the energy range from 50 keV to 1 MeV. (SJR)

7519 RESISTIVE INSTABILITY OF A RELATIVISTIC ELECTRON RING IN A WAVEGUIDE. Korenev, I. L.; Yudin, L. A. Tr. Radiotekh. Inst.; No. 9, 144-152(1972). (In Russian).

The instability of an electron ring moving along the axis of a waveguide is considered. Increments of instabilities of the azimuthal and transverse oscillations are calculated within the limiting cases of a low and high axial velocity of the ring. (SJR)

7520 RADIATION LOSSES OF ELECTRON RINGS IN NONHOMOGENEOUS STRUCTURES. Voskresenskii, G. V.; Kurdyumov, V. N. Tr. Radiotekh. Inst.; No. 9, 153-202(1972). (In Russian).

Original studies are reviewed that deal with determining radiation losses in nonhomogeneous structures as a function of the energy of electron rings. Consideration is given to both individual inhomogeneities of the waveguide path and also to periodic structures. In those cases where the results of various studies contradict each other, reasons for the differences are pointed out. The main attention has been devoted to problems arising during development of accelerator models of electron rings. (tr-auth)

7521 LONGITUDINAL FORCES IN A CYLINDRICAL CONFIGURATION OF ROTATING RELATIVISTIC ELECTRONS. Levin, M. L. Tr. Radiotekh. Inst.; No. 9, 136-143(1972). (In Russian).

Formulae are derived for the longitudinal forces acting on rotating relativistic electrons occupying the volume in a thin-walled cylindrical vessel. (tr-auth)

7522 PARTICLE ACCELERATOR DESIGN: COMPUTER PROGRAMS. Colonias, J. S. New York; Academic Press, Inc. (1974). 316p. $23.50.

The mathematical development, operating procedures, organization, and application techniques for some computer programs for accelerator design are given. Programs are given for the calculation of magnetic and electric fields and for the calculation of orbits of particles in a magnetic and/or electric field. Also, some representative programs useful in the design of linear accelerator-type cavities are given. (123 references) (HWK)

7523 STABILITY OF MOTION IN AN IRON-FREE QUADRUPOLE-FOCUSING ACCELERATOR. Vashkevich, V.K.; Gavrilov, N.M. (Moscow Engineering Physics Institute). Sov. Phys.-Tech. Phys. 18: No. 6, 789-790 (Dec 1973).

A currently important problem is that of developing efficient new miniature systems for focusing. One such system is based on iron-free quadrupole focusing. Questions related to the calculation of magnetic fields and their gradients in a system of four parallel conductors carrying currents are treated. The equations of motion of heavy charged particles are derived taking account of the repulsive effect of the accelerating electric field and the focusing effect of the iron-free quadrupole lenses. An equation is found for analyzing the stability of the particle motion. (auth)

7524 IRON-FREE PASSIVE LINEAR INDUCTION ACCELERATOR. Bashmakov, U.A.; Belovintsev, K.A.; Bessonov, E.G.; Vazdik, Y.A.; Nikolaev, S.M.; Cherenkov, P.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.-Tech. Phys. 18: No. 5, 696-697 (Nov 1973).

Calculations are performed on the production of high-intensity electron beams by a linear induction accelerator. (AIP)

Storage Rings

7525 (BNL-18804) INTERIM LOW COST 100 GeV ISA. Month, M.; Blumberg, L. N.; Chasman, R. W. (Brookhaven National Lab., Upton, N. Y. (USA)). 17 Apr 1974. 16p. Dep. NTIS $4.00.

A design study of an interim low cost 100 GeV p-p ISA is presented. It is conceived as a first stage toward the ultimate goal of a high energy (200 to 300 GeV) superconducting phase. The guiding principle has been compatibility with the transition to the final superconducting stage. The first phase performance goals are to achieve an average luminosity of 10^{32} cm^{-2} sec^{-1} at a top proton energy of 100 GeV. The primary constraints on the design effort have been to keep down the cost and the electric power consumption. These constraints lead to the choice of small gap (4 cm) aluminum coil dipoles operating at 15.3 kG. However, the beams will be brought together for collision with superconducting magnets in the intersection regions. For this purpose, the experimental insertion dipoles designed for the superconducting ISA can be used. The resultant design cost estimate is $69.2 M, while the total electric power consumption is estimated to be 25 MW. The option of storing electrons is considered, providing an e$^-$p luminosity of ~10^{32} cm^{-2} sec^{-1}. (auth)

7526 (BNL-18809) BEAM LOSS IN A COASTING BEAM FROM A HIGH ORDER ISOLATED RESONANCE. Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 3p. (CONF-740522-4). Dep. NTIS $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

It is well known that nonlinear detuning stabilizes high order isolated nonlinear resonances. On the other hand, for a system with changing tune, small amplitude particles can "lock-into" a resonance and be carried to large amplitudes. In coasting beams, such as the ISR beams, there is no obvious dynamic process to provide tune changes. However, it has been pointed out that scattering processes, such as intrabeam p-p scattering, induce momentum diffusion and, through the chromaticity, tune diffusion. In this way, particles can "pass through resonances". Using a random-walk model of the diffusion process, a simple expression for the fractional current loss rate is derived. Estimates for the loss rate are compared with ISR observations and are found to be in agreement. It might be emphasized that the model of beam loss presented here uses only the classical theory of nonlinear resonances. (auth)

7527 (BNL-18821) ISABELLE DESIGN STUDY OF INTERSECTING STORAGE ACCELERATORS. Hahn, H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 10p. (CONF-740522-3). Dep. NTIS $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The present status of the ISABELLE design study for 200 × 200 GeV proton intersecting Storage Accelerators at Brookhaven is presented. The most prominent features of this machine are the high center-of-mass energy of at least 400 GeV, the high luminosity of up to 10^{33} cm^{-2} sec^{-1}, the flexibility of the experimental insertions, and the use of superconducting magnets for bending and focusing of the beams. A general description of the design considerations and the main parameters is given. The possibility of future options, in particular the addition of a 15-GeV electron ring, is discussed. (auth)

7528 (BNL-18823) MAGNETIC AND THERMAL STABILITY OF SUPERCONDUCTING ACCELERATOR MAGNETS. Sampson, W. B.; Dahl, P. F.; McInturff, A. D.; Robins, K. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 4p. (CONF-740522-8). Dep. NTIS $4.00.

From ninth international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The two model superconducting storage ring magnets ISA I and II have been subjected to extensive magnetic and thermal cycling to determine the effect of long term operation on their field distribution. The magnets were pulsed using the cycle proposed for ISABELLE (i.e., 100 sec rise, 100 sec fall) but substituting a 10 sec flat top so that a large number of pulses could be run in a relatively short time. The harmonic content of the magnets was measured periodically during the test. No significant changes were observed after a total of 5500 pulses. During the test, which lasted approximately six months the magnets were allowed to warm up to 150 K several times for refrigerator maintenance. They were also cycled to room temperature (300 K) twice after the pulsing test. Again no change in the harmonic coefficients was observed. (auth)

Experimental Facilities

7529 (CONF-740402-17) NEUTRON SPECTRAL MEASUREMENTS IN SPALLATION NEUTRON SOURCES: CHARACTERIZATION OF THE BLIP NEUTRON FACILITY. Dudey, N. D.; Parkin, D. M.; Heinrich, R. R.; Fluss, M. J. (Argonne National Lab., Ill. (USA)). 1974. 11p. Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

As a part of the evaluation of spallation neutron sources for radiation test facilities in the CTR materials programs, the spectral characteristics of a neutron test facility, the Brookhaven Linac Isotope Producer (BLIP), were studied. This facil-

ity produces neutrons from the interaction of 200-MeV protons on a beryllium target. Foil-activation spectral-unfolding techniques were used to deduce the neutron spectrum and the flux and spectral symmetry around the neutron source. The derived spectrum was found to consist of two components, one peaking in the 8 to 10 MeV energy region, the other having an intensity proportional to $1/\sqrt{E}$ below 0.25 MeV. Flux levels exceeding 1×10^{11} n/cm²-sec were measured. The close-in geometries required to achieve practical flux levels will contribute several problems if used for irradiation-effects studies. These include (1) spillage of the primary proton beam into the irradiation region, (2) flux and spectral asymmetry around the target, and (3) instability of the flux and spectrum with time due to beam instability. Foil-activation techniques were found to be capable of characterizing the neutron spectrum, but at present adequate cross-section data are lacking, particularly above 18 MeV. In addition, the accuracy of the spectral results is dependent upon the initial input spectrum, the choice of monitor reactions, and the accuracy of the reaction-rate data. (auth)

7530 (FEI-338) METAL LITHIUM TARGET FOR NEUTRON PRODUCTION. Kononov, V. N.; Metlev, A. A. (Gosudarstvenny] Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 5p. (In Russian). INIS.

A metallic Li target for production of neutrons in electrostatic accelerators is described. The target makes it possible to eliminate the significant γ background with high energies. It gives a 3 times greater neutron yield than targets of LiF. (tr-auth)

7531 (JU-RR-73-6) HELIUM-JET TRANSPORTATION OF RECOIL ATOMS INTO A LIQUID PHASE. Puumalainen, P.; Aeystoe, J.; Valli, K. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Mar 1973. 11p. INIS.

A rapid inexpensive method has been developed for transportation of recoiling short-lived radioactive nuclides from a target chamber over distances of several meters into a liquid phase. This allows rapid radiochemical separation of different elements. The carrier-loaded helium-jet transport technique is employed without a pumping system. The transport efficiency is higher than 50 percent and the transport time can be made much shorter than 1 s. Radiochemical separation times of a few seconds were achieved. (auth)

7532 (ORNL-TM-4562) SUPERA, A DISPLAY AND ANALYSIS SYSTEM FOR THE VT-15 GRAPHICS DISPLAY. Thompson, C. L.; Craven, J. G.; Foster, P. B. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 38p. Dep. NTIS $5.00.

SUPERA is a PDP-10 MACRO-10 assembly language program for the display, examination, analysis and plotting of experimental data at the VT-15 Graphics Display Stations at the Oak Ridge Electron Linear Accelerator. (auth)

7533 (ORNL-TM-4563) DSPSYS, AN INTERACTIVE DISPLAY AND ANALYSIS SYSTEM FOR THE VT-15 GRAPHICS DISPLAY. Thompson, C. L. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 29p. Dep. NTIS $4.50.

DSPSYS is a PDP-10 program using the VT-15 Graphics Display for the display, manipulation, analysis and plotting of data taken on the Oak Ridge Electron Accelerator. DSPSYS is designed to be, and is, the foundation of systems of analysis programs run on the ORNL timesharing PDP-10 and the IBM-360's. (auth)

7534 SEALED CONTROLLED-ENVIRONMENT CHAMBER FOR POLYMER GRAFTING WITH ELECTRON ACCELERATORS. Amdur, S.; Waldner, G.; Rajbenbach, L. A. (Soreq Nuclear Centre, Yavne, Israel). Nucl. Instrum. Methods; 117: No. 1, 85-87 (1974).

A controlled-environment box for experimentation in the irradiation of flexible materials in sheet form (usually polymeric films) with electron accelerators (550 kV, 20 mA) was designed and built. The apparatus is suitable for use in studies of grafting to polymers in controlled environment. It permits grafting of liquid- or vapor-phase monomer onto a solid film both by pre- or post-irradiation techniques. The use of this chamber affords a favorable opportunity for the study of the optimum conditions for electron-accelerator use in possible industrial processes. (auth)

7535 SYSTEM FOR BEAM DETECTION AT 0° USING A TRIPLE QUADRUPOLE MAGNETIC LENS. Laurent, H.; Schapira, J. P.; Fortier, S.; Gales, S.; Maison, J. M. (Institut de Physique Nucleaire, Orsay, France). Nucl. Instrum. Methods; 117: No. 1, 17-27 (1974). (In French).

A new system in which charged particles are detected at 0° with respect to the incident beam has been designed. It used the focusing properties of three magnetic quadrupoles operating in the symmetric mode. The major advantage of this system is its large average solid angle of 12×10^{-3} sr subtending an energy range of 20% of the mean value; it operates with a simple single circular counter of an area of 300 mm², and can be used for particle-gamma or particle-particle studies, according to the Litherland and Ferguson method. (auth)

7536 NUCLEAR REACTION CHAMBER SYSTEM FOR RESEARCH WITH HEAVY-ION PARTICLE BEAMS. Feldl, E. J. (Kansas State Univ., Manhattan). Nucl. Instrum. Methods; 117: No. 1, 5-7 (1974).

A reaction chamber was designed and constructed to meet the more stringent requirements of experiments with heavy-ion beams and crystalline targets. Deposits and effects of residual gas particles are minimized by operating in the 10^{-9} torr range and by the exclusion of organic materials in the construction of the chamber. All features of conventional high-precision target chambers, such as rotatable detector mounts, target air lock, external and remote controls for target and detector orientation, were retained and improved. (auth)

7537 CAMAC SINGLE CRATE CONTROLLER FOR SYNCHRONIZED DMA TRANSFERS AND AN ADC INTERFACE MODULE. LaSalle, R. A. (Florida State Univ., Tallahassee). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 928-930(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A single crate controller has been developed to run with an automatic, blocking DMA channel. The execution of a CAMAC command stored in the controller is triggered by a selected LAM. An analog-to-digital (ADC) interface module utilizes the features of this controller module to store multiparameter pulse height analysis data in a core memory buffer. Four ADC's can be operated in combinations of singles and coincidence mode with automatic stacking provided. The above modules have been in operation at the Florida State University Van de Graaff lab since February, 1973. (auth)

7538 QUICK PNEUMATIC RABBIT DEVICE FOR NEUTRON ACTIVATION. Sandor, S.; Katalin, J. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 4, 317-319(1973). (In Hungarian).

A fast-acting rabbit device was developed to study low-cross-section nuclear reactions initiated by 14-MeV monoenergetic neutrons, avoiding the disturbing background caused by the bombarding neutrons. The distance of 2.8 meters between activation and detection was determined by the shielding requirements. In order to achieve a short time of flight, an unclad 6-mm long, 1.8-mm-dia target weighing 14 mg was used; the target was moved within a 2-mm-dia polyethylene tube by pressure or suction through a rubber membrane, and its position for activation or detection was determined by inserted polyethylene conical bumpers. The specimen could be sent to the detector within 0.5 sec; its arrival was signaled by a photodiode position indicator, which started the operation of the multichannel analyzers. The system may be used to handle any solid-metallic or ceramic-specimen. (TTT)

7539 SHIELDING FROM NEUTRONS GENERATED IN TARGETS BY A BEAM OF 1 GeV PROTONS. Man'ko, B. V.; Sychev, B. S. Tr. Radiotekh. Inst.; No. 9, 117-126(1972). (In Russian).

Calculations were made on the spectral-angular distribution of high-energy neutrons emitted from thick and thin targets of copper bombarded by protons. The initial proton energy was varied from 40 to 1000 MeV. Attenuation functions for the neutron flux were calculated in shielding made of concrete and iron. The spectral distribution of neutrons striking the shielding was determined by the neutron emission angle with respect to the primary proton beam bombarding the target. The neutron emission angle was varied from 0 to 180°. (tr-auth)

7540 ELECTRON DIFFRACTION INSTRUMENT USING THE HIGH-ENERGY BEAM OF LINAC. Watanabe, M.; Taoka, T.; Ohta, S.; Anazawa, N.; Kato, S. (Japan Electron Optics Lab. Co. Ltd., Akishima). J. Phys., E (London); 7: No. 5, 412(May 1974).

A preliminary experiment has been conducted for the purpose of using the linear accelerator as a high-energy electron source, instead of a Cockcroft-Walton type accelerator. The experiments showed that the electron orbits in the accelerator were in accordance with results expected from calculations and controllably connected with the orbits in the outer field of the lens. The pulsed-field emission gun could be operated with very high stability and the emitter life was found to be considerable. However, for the electron microscope, the gun lacked beam intensity and, therefore, had to be scaled up. The energy distribution of the LINAC

beam was improved by stabilizing the microwave power and using the presetter. (UK)

7541 RAPID HIGH RESOLUTION X-RAY TOPOGRAPHY WITH SYNCHROTRON RADIATION. Tuomi, T. (Helsinki Univ. of Tech., Otaniemi, Finland); Naukkarinen, K.; Laurila, E.; Rabe, P. Acta Polytech. Scand., Phys. Nucl. Ser.; No. 100, 1-8(1973).

Synchrotron radiation was used to take x-ray diffraction topographs. Because of the special properties of synchrotron radiation the exposure time was found to be shorter by a factor of 10^3 to 10^4 than that using the characteristic radiation from a conventional x-ray tube. Several Laue reflections are obtained at the same short time, typically about 30 s. As an example a high resolution topograph of a silicon crystal taken with the new method is presented. (auth)

7542 NEUTRON BACKGROUND OF THE B-25/30 BETATRON AT THE ELECTROMAGNET AIR GAP. Brovtsyn, V. K. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geo-Chemistry, Moscow). pp 105-113 of Nedestruktivnye Aktivatsionnye Metody Analize Nekotorykh Vidov Mineral'nogo Syr'ya i Primenyaemaya Apparatura. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

Activation of Mn detectors was used in the study of the distribution of the background thermal and epithermal neutron flux in the electromagnet air gap of the B-25/30 betatron with maximum-energy bremsstrahlung and of its dose rate. At a 90° angle to the axis of the bremsstrahlung there was a practically pure neutron field, not accompanied by a markedly dispersed bremsstrahlung. This field may be used for neutron activation analysis of rock and ore samples. (tr-auth)

7543 UTILIZATION OF ACCELERATORS FOR THE CURING OF PAINTS. Kishi, N.; Kobayashi, S. (Mitsubishi Rayon Co. Ltd., Tokyo). Genshiryoku Kogyo; 19: No. 5, 25-29(May 1973). (In Japanese).

In order to dry paint forcibly, a new method of polymerizing and bridging the paint by electron beam has been developed. Development of electron beam accelerators and the peripheral engineering has been almost completed, and now development of the paint suitable for the purpose is the point to make this system successful. The accelerators used for curing paint are those of 300 to 700 kV accelerating voltage, 50 to 200 mA current within tubes, and 60 to 180 cm scanning width. As for the shape of painted objects, plane objects are most suitable, but polyhedrons can be cured by turning the objects or with many accelerators. Radiation dose required for curing is usually 2 to 20 Mrad. Low dose curing at high dose rate is possible with a new type of resin. When oxygen in the surface layer of paint is eliminated at the time of electron beam irradiation, freedom of selecting the paint increases remarkably, therefore the inert gas sealing is desirable. A few examples of the electron beam curing are shown. (JA)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

7544 CRISIS IN ASTRONOMY. Hoyle, F. (California Inst. of Tech., Pasadena). pp 62-78 of Physics 50 Years Later. Brown, S. C. (ed.). Washington, DC; National Academy of Sciences (1973).

The possible discrepancy in the red shift-distance relation is discussed. Various observational data showing this descrepancy are considered. The need of new physical ideas is pointed out. (JFP)

Cosmic Radiation

Refer also to abstracts 6636, 7564, 7772, 7824, 7859, 8046, 8052, 8159, and 8191.

7545 (AD-764539) EARTH ALBEDO NEUTRONS FROM 10 TO 100 MeV. Preszler, A. M. (California Univ., Riverside (USA). Inst. of Geophysics and Planetary Physics). 1 Jul 1973. Contract N00014-69-A-0200-5001. 176p. (IGPP-UCR-73-37). NTIS $5.25.

Neutrons produced by the interaction of primary cosmic rays with atmospheric nuclei have been measured at energies from 10 to 100 MeV and angles from 20 to 80° to the vertical. The data were taken on a balloon flight from Palestine, Texas, 40° N geomagnetic latitude, on September 26, 1971. A telescope constructed of two large area tanks of liquid scintillator measured the incident neutron's energy and direction. Results of calibrations with neutrons of 55 and 15.3 MeV are presented. (GRA)

7546 (AD-765906) ANGULAR DISTRIBUTION AND ALTITUDE DEPENDENCE OF ATMOSPHERIC NEUTRONS FROM 10 to 100 MeV. Preszler, A. M.; Simnett, G. M.; White, R. S. (California Univ., Riverside (USA). Inst. of Geophysics and Planetary Physics). 27 Jul 1973. Contract N00014-69-A-0200-5004. 33p. (IGPP-UCR-73-25). NTIS $3.00.

The altitude dependence of atmospheric neutrons from ground level to 5 g/sq cm of residual atmosphere at neutron energies of 10 to 100 MeV is reported. Ground level measurements were taken at Cape Girardeau, Missouri, on September 18, 1972. The other measurements were made during ascent and float on launch from Palestine, Texas on September 26, 1971. The intensity of both the downward and upward moving neutrons is maximum at about 100 g/sq cm of residual atmosphere. Neutron angular distributions are reported from 20 to 80° degrees and 100 to 160° for 10 to 100 MeV neutrons. Omnidirectional fluxes at altitudes at 5, 50, 100, and 200 g/sq cm residual atmosphere are in good agreement with recent theoretical calculations of Armstrong et al. in the three energy intervals of 10 to 30, 30 to 50, and 50 to 100 MeV. (auth)

7547 (CEA-R-4559) MONTE CARLO COMPUTATION FOR ISOTOPIC ANALYSIS OF COSMIC RAYS BY MEANS OF THE EARTH MAGNETIC FIELD. Hubert, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Apr 1974. 19p. (In French). Dep. NTIS (US Sales Only) $4.00.

Filtering of charged cosmic rays arriving through the geomagnetic field is evaluated from the results of numerical integration performed on a large number of randomly selected trajectories. The random procedure follows a consequence of Liouville theorem. It takes into account the shape of the external spectrum and the geometrical conditions of the experiment. After rejecting the forbidden trajectories, it is possible to predict the shape of an experimental spectrum if the response curve and the dispersion of the detector are known. The isotopic composition can then be deduced from a comparison between computed and measured spectra. The time required for a given precision is computed as an example, in the case of a possible experiment. (auth)

7548 (N-73-30770) LUNAR SURFACE COSMIC RAY EXPERIMENT S-152, APOLLO 16. Final Report. Fleischer, R. L.; Hart, H. R. Jr.; Carter, M.; Comostock, G. M.; Renshaw, A.; Woods, R. T. (General Electric Co., Schenectady, N. Y. (USA). Physics and Electrical Engineering Lab.). 25 Jul 1973. Contract NAS9-11468. 67p. (NASA-CR-134019). NTIS $5.50.

This investigation was directed at determining the energy spectra and abundances of low-energy heavy cosmic rays (0.03 E or = 150 MeV/nucleon). The cosmic rays were detected using plastic and glass particle track detectors. Particles emitted during the April 17, 1972 solar flare dominated the spectra for energies below about 70 MeV/nucleon. Two conclusions emerge from the low-energy data: (1) The differential energy spectra for solar particles vary rapidly for energies as low as 0.05 MeV/nucleon for iron-group nuclei. (2) The abundance ratio of heavy elements changes with energy at low energies; heavy elements are enhanced relative to higher elements increasingly as the energy decreases. Galactic particle fluxes recorded within the spacecraft are in agreement with those predicted taking into account solar modulation and spacecraft shielding. The composition of the nuclei at energies above 70 MeV/nucleon imply that these particles originate outside the solar system and hence are galactic cosmic rays. (auth)

7549 SEMIEMPIRICAL RATES OF FORMATION OF COSMIC-RAY TRACKS IN SPHERICAL OBJECTS EXPOSED IN SPACE: PREATMOSPHERIC AND POSTATMOSPHERIC DEPTH PROFILES. Bhattacharya, S. K.; Goswami, J. N.; Lal, D. (Tata Inst. of Fundamental Research, Bombay). J. Geophys. Res.; 78: No. 34, 8356-8363(1 Dec 1973).

Observations of fossil tracks in meteorites and lunar rocks are used to estimate long-term averaged production rates of tracks due to cosmic ray multicharged nuclei in common silicates in spherical meteorites. Results are presented graphically for track production rate (TPM, tracks/cm^2 m.y.) versus depth in meteorites with radii of 3 to 500 cm. Track production profiles are also presented for TPM values expected at the surface of a uniformly ablated meteorite as a function of ablated depth for "recovered," i.e., postatmospheric, radii values of 3 to 500 cm. In the case of meteorites having a "single" exposure history their cosmic ray exposure age is given by measurements of cosmogenic gases, e.g., ^{3}He and ^{22}Ne. This procedure allows an estimation of TPM values at the surface of the meteorite from the observed track densities. The TPM curves presented herein then suffice to deduce the ablation during atmospheric transit of a spherical meteorite for cases where the assumption of a uniform burn is a reasonable approximation. Errors in the deduced extent of ablation due to uncertainties in the estimated TPM values and the size of the recovered meteorite are discussed. (auth)

7550 ENHANCED DIURNAL VARIATION OF COSMIC RAY. Bussoletti, E. (Observatoire de Paris, Meudon, France). ELDO/ESRO Sci. Tech. Rev.; 5: No. 3, 285-299(1973).

Enhanced diurnal intensity variations that occurred in the October 1965-April 1968 period were studied using data from several high-latitude neutron monitors. The method of analysis used enabled two-dimensional time-space maps to be obtained of the anisotropy together with its north-south pattern. The results confirm the existence of a new and unexpected anisotropy trend: frequently occurring large reinforcements from the co-rotation which takes place in addition to a reduction in cosmic-ray intensity along the spiral direction of the interplanetary field. (FR)

7551 UPPER LIMIT ON THE LOW ENERGY INTERSTELLAR COSMIC-RAY FLUX. Meszaros, P. (Cambridge Univ., Eng.). Nature (London); 248: No. 5443, 35-36(1 Mar 1974).

It is stated that although determinations of the flux of low-energy nonsolar cosmic rays extend at present down to 5 to 10 MeV for observations above the Earth, the interstellar flux of cosmic rays below 1 GeV is highly uncertain because of solar modulation effects. The interstellar differential energy spectrum in the range 10 MeV to 1 GeV is usually deduced from theoretical models by choosing more or less plausible interplanetary diffusion coefficients that give a fit to the data. The state of sophistication of these theories is, however, far from satisfactory. Predicted values of the demodulated flux vary by orders of magnitude with different authors, and until now there have been no experimental data on the interstellar flux to assist in model selection. It is pointed out, however, that there exists an indirect experimental upper limit for the interstellar low-energy flux based on determinations of the state of ionization of the trace elements in the interstellar gas as obtained from the OAO 3 Copernicus satellite. A comparison of these results with those expected if the ionization were due to low-energy cosmic rays allow a direct upper limit to be placed on the number of ionizations per second that an interstellar H atom would undergo from cosmic rays. (UK)

7552 RECENT PROGRESS IN COSMIC RAY PHYSICS. Quenby, J. J. (Imperial Coll. of Science and Tech., London). Contemp. Phys.; 15: No. 2, 97-120(Mar 1974).

This article outlines the state of cosmic-ray physics, as at the August 1973 International Cosmic Ray Conference. It deals with geophysical effects, solar modulation of the cosmic ray flux, the source of energetic solar particles and their energy, and cosmic rays from galactic sources; and concludes with an account of the relationships between cosmic-ray work and accelerator physics. (auth)

7553 LEAKAGE OF COSMIC RAYS FROM THE GALAXY. McIver, I.; Skilling, J. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 49-54(Apr 1974).

A model is constructed for the confinement of cosmic-ray particles within the Galaxy by hydromagnetic waves, themselves generated by a slow leakage of such particles. An "equation of state" is derived for the cosmic rays, as they escape, and, among other consequences of the model, the leakage rate is found to increase with particle energy. (auth)

7554 MOMENTUM SPECTRA OF NUCLEAR ACTIVE PARTICLES IN THE COSMIC RADIATION AT SEA LEVEL. II. A Review of Predictions. Hook, J. R.; Turver, K. E. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 6, 765-778(11 Apr 1974).

Computer simulations have been made of the propagation through the atmosphere of protons and pions using a model developed primarily for high-energy air-shower studies. The results are compared with those from other recent simulations and with measurement. There is little agreement between the results of the various simulations; the results of the present work based upon a simple model and assuming reasonable values for the primary intensity, are in broad agreement with the observational data. (auth)

7555 ORIGIN OF ENERGETIC COSMIC RAYS. III. One-Dimensional Diffusion from Random Sources. Dickinson, G. J.; Osborne, J. L. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 6, 728-740(11 Apr 1974).

The model of cosmic ray propagation by one-dimensional diffusion along randomly wandering field lines proposed by Jones (Proc. 12th Int. Conf. on Cosmic Rays, Hobart Vol. 1 396-400 (1971)) is developed by considering the effect of random discrete sources on the concentration, anisotropy, and mean age of cosmic rays along a line of magnetic flux. This mode of propagation is taken to be valid in the energy range 10^{11} eV to 10^{14} eV. The experimental information on the galactic anisotropy, mean age, and constancy of the cosmic-ray flux is briefly stated. The probability of our being at a time in the Earth's cosmic-ray history when the fluctuating anisotropy is by chance at its relatively low observed value is evaluated for a number of values of the parameters of propagation. (auth)

7556 CHANGE IN THE UPPER LIMITING RIGIDITY FOR THE COSMIC RAY DIURNAL INTENSITY VARIATION FROM 1965–1971. Begum, Q. N. (Univ. of Dacca, Bangladesh). J. Phys., A (London); 7: No. 6, L80-L84(11 Apr 1974).

The change in the upper limiting rigidity for cosmic-ray particles undergoing diurnal modulation has been studied for the period 1965 to 1971 using neutron monitor and muon telescope observations. The limiting rigidity is shown to vary from a minimum value of about 35 GV in 1965 to a maximum of about 125 GV in 1970. (auth)

7557 THEORY OF PERTURBATION OF THE LOWER IONOSPHERE BY A METAL BODY. Yastrebov, A. A. Tr. Tsent. Aerol. Observ.; 3: 35-43(1972). (In Russian).

The problem of perturbation of a dense, weakly ionized plasma by a stationary charged body of spherical shape was investigated. It is shown that as a consequence of the large number of collisions of charged particles with atoms and molecules of neutral gas, the depleted concentration zone is considerably greater than the Debye layer and the dimensions of the body (depletion effect). Thus, making probe measurements in the lower ionosphere involves accounting for the plasma depletion in the vicinity of the probe due to charging of the rocket hull and of the probe itself. (auth)

7558 ENERGY SPECTRUM OF GAMMA QUANTA ON A MOUNTAIN TOP. Emel'yanov, Yu. A.; Lukin, Yu. T.; Sadykov, T. Kh. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 72-73 (1973). (In Russian).

The energy spectrum of the electromagnetic component in the region of zenith angles above 17° was obtained. The index of the energy spectrum in this range does not differ from the index for the vertical flux of γ quanta. On the basis of the integral distribution according to the zenith angle the mean free absorption path of the electromagnetic component in the energy range from 10^{12} to 10^{13} eV was calculated. (tr-auth)

7559 THE DIRECTION AND SPECTRAL VARIABILITY OF A COSMIC GAMMA-RAY BURST. Wheaton, W.A.; Ulmer, M.P.; Baity, W.A.; Datlowe, D.W.; Elcan, M.J.; Peterson, L.E. (University of California, San Diego); Klebesadel, R.W.; Strong, I.B.; Cline, T.L.; Desai, U.D. Astrophys. J. Lett. 185: No. 2, L57-L61 (15 Oct 1973).

We report the simultaneous observations of a γ-ray event with six different X-ray and γ-ray instruments: (1) the Los Alamos γ-ray detectors on three Vela satellites; (2) the GSFC solar-flare γ-ray detector on the IMP-6 satellite; (3) two UCSD X-ray telescopes on board the OSO-7. This event was observed from ~7 to 1500 keV. Eight spectra at 10.24-s intervals were determined over the 11-100 keV range; power-law ($F \propto E^{-\alpha}$ photons cm^{-2} s^{-1} keV^{-1}) spectra with α from ~.77 to 1.5 fit the data over this range. The highest intensity intervals have the flattest spectra. The total energy of the event (~80 s duration) was $\sim 5\times10^{-4}$ ergs cm^{-2}. The direction of the event was unambiguously determined from the UCSD cosmic X-ray telescope with a 90 percent confidence, 4° error radius, as $\alpha = 177°.7$, $\delta = 74°.5$. This was in agreement with one of two possible directions determined independently by the Vela satellites which was $\alpha = 172°$, $\delta = 77°$, with a 5°, 90 percent confidence error radius. (auth)

7560 LONG-TERM FLUXES OF HEAVY COSMIC-RAY NUCLEI BASED ON OBSERVATIONS IN METEORITES AND LUNAR SAMPLES. Bhandari, N.; Goswami, J.N.; Lal, D.; Tamhane, A.S. (Tata Institute of Fundamental Research, Bombay, India). Astrophys. J. 185: No. 3, 975-983 (1 Nov 1973).

We present here results of observations of fossil tracks due to very heavy (VH) and very very heavy (VVH) cosmic-ray nuclei ($Z > 20$ and $Z \geq 30$, respectively) in a variety of extraterrestrial samples—lunar and meteoritic. These samples represent irradiation by solar as well as galactic cosmic rays during the past 10^3–10^9 years, with effective shielding depths of 10^{-3}–10 cm of typical stony material, corresponding to the kinetic-energy interval (6–1500) MeV per nucleon. Based on these data, we have deduced the average kinetic energy spectrum of VH and VVH nuclei in the ancient cosmic radiation. Our observations indicate that (i) at energies less than 10 MeV per nucleon, the VH and VVH nuclei are entirely of solar origin and (ii) the relative abundance of $(Z \geq 30)/(Z > 20)$ nuclei is almost constant in the kinetic-energy interval (50–10^3) MeV per nucleon, but that at lower energies, less than 30 MeV per nucleon, the heavier nuclei progressively become more abundant. The ratio of abundance, $(Z \geq 30)/(Z > 20)$, increases by more than a factor of 3 in going down from 50 to 6 MeV per nucleon. (Effects of shielding geometry and erosion during irradiation have been considered; their effects are found to be unimportant for the conclusions drawn here.) Taking into account typical erosion rates, the exponents in the power-law kinetic-energy spectra of solar VH and VVH nuclei are determined to be –3 and –5, respectively. (auth)

7561 SPATIAL DEPENDENCE OF THE PITCH-ANGLE AND ASSOCIATED SPATIAL DIFFUSION COEFFICIENTS FOR COSMIC RAYS IN INTERPLANETARY SPACE. Voelk, H. J.; Morfill, G.; Alpers, W.; Lee, M. A. (Max-Planck-Institut fuer Physik und Astrophysik, Garching; Muenchen (F. R. Germany). Inst. fuer Extraterrestrische Physik). Astrophys. Space Sci.; 26: No. 2, 403-430(Feb 1974).

The spatial dependence of the pitch-angle and associated spatial diffusion coefficients for cosmic ray particles in interplanetary space is calculated in the WKB approximation. The model considers only Alfven waves of solar origin to be responsible for scattering of moderate energy particles. After developing the general theory results are presented for the asymptotic case corresponding to radial distances r greater than about 1 to 2 AU. The radial diffusion coefficient κ_r increases with energy E like $\kappa_r \sim E^{\nu}$, where $\nu \sim 2/3$. The radial mean free path turns out to increase proportionally to r^3 at medium and low heliographic latitudes. This behavior is consistent with a very small radial cosmic ray gradient and the existence of a "free boundary" for particle diffusion. At equal radial distances the high latitude mean free path is not only much smaller than the one calculated at the lower latitudes but in addition increases only weakly with distance. Some conceivable dynamical implications for the outer solar system are indicated. (auth)

7562 THE COSMIC DIFFUSE GAMMA-RAY FLUX AT 10 MeV. Kuo, F.; Frye, G.M. Jr.; Zych, A.D. (Case Western Reserve University, Cleveland, Ohio). Astrophys. J. Lett. 186: No. 2, L51-L54 (1 Dec 1973).

The cosmic diffuse γ-ray flux at 10 MeV has been measured by a spark-chamber technique on a balloon flight at 3 g cm^{-2}, 4.5 GV geomagnetic cutoff. The flux at 10 MeV is $(8.0 \pm 4.5) \times 10^{-4}$ γ's (cm^2 s sterad MeV)$^{-1}$ where the error is due to the uncertainty in the atmospheric flux. The measured value is an order of magnitude above the extrapolation of the power law which holds below 1 MeV. (auth)

7563 UPPER LIMIT TO THE COSMIC DIFFUSE GAMMA-RAY FLUX AT 40–100 MeV. Hopper, V.D.; Mace, O.B.; Thomas, J.A. (Physics (RAAF) Department, University of Melbourne, Melbourne, Australia); Albats, P.; Frye, G.M. Jr.; Thomson, G.B.; Staib, J.A. Astrophys. J. Lett. 186: No. 2, L55-L58 (1 Dec 1973).

Atmospheric growth curves from balloon-borne spark chambers at 5 to 1.3 mb have been used to set upper limits on the cosmic diffuse γ-ray flux of 1.6×10^{-3} and 1.0×10^{-4} γ's (cm^2 s sterad MeV)$^{-1}$ at 40 and 100 MeV. When combined with the positive results at 10 MeV of Kuo et al. or Trombka et al., these limits imply an E^{-3} spectrum between 10 and 100 MeV. (auth)

Stars

Refer also to abstracts 7686, 7697, 7713, 7822, 8370, and 8377.

7564 (NP-19988) MAGNETIC ACCRETION PROCESSES AND ATMOSPHERIC PECULIARITIES IN MAGNETIC STARS AND THE ROLE OF THESE STARS AS COSMIC RAY SOURCES. Havnes, O. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). 1974. 61p. Dep. NTIS (US Sales Only) $6.25.

Thesis.

A theory of magnetic accretion processes in Peculiar A stars is first presented qualitatively and then treated quantitatively. Because magnetospheres such as the Earth's pick up particles it was realized that those of magnetic stars would do likewise. It was found that atoms and ions from interstellar gas may enter the stellar magnetosphere driven by the electromagnetic field of the rotating magnetosphere or by the star's gravitational field, and become trapped. The particles then diffuse out of the particle belts and down to the stellar surface, which gradually changes its composition toward that of the particle belts. The particles descend preferentially near the magnetic poles and form abundance spots there. Good accordance between calculated and observed abundances supports this theory. The slow rotation of these stars may be explained by the interaction between the ionized component of the interstellar gas and the rotating stellar magnetosphere. Ions not trapped are likely to leave the magnetosphere with a large increase in velocity, the magnetosphere and its magnetic field acting like a magnetic mirror, and large cosmic-ray velocities may be obtained by the ions. The required energy input for cosmic rays in the Galaxy is such that cosmic rays from magnetic stars can account for at the most 10% of this energy. Cosmic rays from magnetic stars may, however, be mainly emitted in the low-energy part of the cosmic-ray energy spectrum and may play a more dominant role there. (NO)

7565 CIRCUMSTELLAR ABSORPTION SYSTEMS OF THE DELPHINI 1967 NOVA. Malakpur, I. (Centre National de la Recherche Scientifique, Paris). Compt. Rend., Ser. A, B; 277: No. 24, 735-737(17 Dec 1973). (In French).

Absorption systems having constant radial velocities were observed at the beginning of the Delphini nova activity. Such systems have been designated circumstellar absorption systems, since the matter for their existence is that of the circumstellar envelope enclosing the nova before its explosion, this matter being ejected by the shock wave. (FR)

7566 NUCLEAR REACTIONS INDUCED BY MACRO–MICRO INTERACTIONS IN SUPER-DENSE STARS. Amte, P. G. (Rajaram Coll., Kolhapur, India). Indian J. Phys.; 47: No. 10, 637-638(Oct 1973).

Some baryon stars may have densities of 10^{15} to 10^{16} gms per cc and higher. The distance between the centers of the baryons under such conditions is 10^{-13} cm and the matter can be considered to be a macroscopic system in which quasi particles exist as excitations of the system. Such quasi particles may induce nuclear reactions by their interaction with a microparticle in the material of the star. (MCW)

7567 MICROTURBULENT VELOCITIES OF SOUTHERN F-TYPE SUPERGIANTS. Castley, J. C. (Tasmania Univ., Sandy Bay, Australia). Proc. Astron. Soc. Aust.; 2: No. 4, 200-202(Oct 1973).

Coude spectra were obtained for a selection of giant and supergiant stars having spectral types in the range A9 to F2 to determine their atmospheric characteristics. Delta Canis Majoris (F81a) which has been the subject of many detailed investigations, was also observed to check for possible systematic errors in the equivalent widths. The spectra were obtained using the Coude spectrograph of the 40 cm reflector at the University of Tasmania Observatory. Linear dispersions of 1.8Å mm^{-1} (0.12Å resolution) in the range 3600 to 4000Å and 2.4Å mm^{-1} (0.18Å resolution) in the range 4000 to 5000Å were used for stars brighter than third magnitude; 9Å mm^{-1} (0.4Å resolution) was used for stars fainter than third magnitude. The classification of 196 Car was observed to be later (F8III) than the listed value and the spectrum of this star was not analyzed further. (AU)

7568 RELAXATION OSCILLATIONS IN RED-GIANT ENVELOPES AND THE SYMBIOTIC STARS. Wood, P. R. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 4, 198-200(Oct 1973).

An explanation of the combination spectrum, variability, and eruptive behavior of symbiotic stars is given in terms of a shock wave heated chromosphere. (AU)

7569 DURATION OF dMe FLARES. Kunkel, W. E. (Cerro Tololo Inter-American Observatory, La Serena, Chile). Nature (London); 248: No. 5449, 571-573(12 Apr 1974).

It has been suggested (Gershberg and Shakhovskaya, Nature Phys. Sci. 242 :85 (1973)) that the time scales for flare development depend principally on the peak amplitude of flare events, implying that stronger events last longer. This suggestion was supported by observations on a number of flare stars. It is here pointed out that the results may have been biased and could not have been interpreted with adequate confidence. Further tests are proposed. There appears to be a strong correlation between mean event duration and stellar luminosity. (UK)

7570 OBSERVATIONS OF THE LINEAR POLARIZATION IN THE Hβ EMISSION FEATURE OF γCAS. Clarke, D.; McLean, I. S. (Univ. of Glasgow). Mon. Notic. Roy. Astron. Soc.; 107: No. 1, 27P-30P(Apr 1974).

Linear polarization measurements have been made across the Hβ emission line of γCas. The results show a significant reduction in the degree of polarization at the emission peak relative to the values in the wings and the continuum. This depolarization effect in the emission feature exhibits variability. (auth)

7571 APPEARANCE OF RELATIVISTIC STELLAR SYSTEMS. Suffern, K. G. (Univ. of Sydney). Aust. J. Phys.; 27: No. 1, 93-104(Feb 1974).

A formula is derived for the projected density distribution on a photographic plate which would arise from a given static spherically-symmetric relativistic stellar system. For weak gravitational fields, a corresponding post-Newtonian expression is derived which is relatively simple to use once a particular proper stellar number density has been specified for the relativistic system under consideration. For application to the outer regions of such a system, this post-Newtonian formula simplifies considerably, and it is possible to solve von Zeipel's problem explicitly for these outer regions to obtain an expression for the proper number density of stars in such a system from the projected density on a photographic plate. It is found that, if Newtonian theory alone were used to calculate the stellar number density in a relativistic system from the projected density, the system so constructed would appear to be less centrally condensed than it really is. (auth)

7572 ENERGY LEVELS OF CA VII FROM OBSERVATIONS OF RR TELESCOPII. Thackeray, A. D. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 87-93 (Apr 1974).

Three lines attributed to [Ca VII] have been found present in the slow nova RR Tel since 1967. Their measured wavelengths lead to slightly revised energy levels of Ca VII. (auth)

7573 ANALYSIS OF COMPOSITE SPECTRA: THE ULTRAVIOLET EXCESS OF STARS IN GLOBULAR CLUSTERS. Bingham, R. G.; Martin, W. L. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 137-161(Apr 1974).

Ultraviolet excesses which are nearly independent of interstellar reddening are estimated for 38 globular clusters. A model-fitting process is used. The data are details of the observed upper part of each individual B–V, V array and the integrated U–B colors. By noting the effects of changes in the data, errors are assessed in a way which may be applicable in other work on the integrated colors of clusters and galaxies. Inconsistencies in the available data are found. A provisional calibration of the ultraviolet excesses in terms of metal-content is possible. Other methods of ordering the clusters in metal-content are considered inferior, but $Q = U-B-0.72\,(B-V)$ is a useful rough indicator of ultraviolet excess. There is a possibly identifiable metal-rich subgroup of clusters, but each cluster has at least a small ultraviolet excess. The positions of the clusters in this sub-group imply that the Galaxy is enriched in metals in a 6 kpc thick, 18-kpc diameter "superdisk." The metal abundance in the superdisk is about one-third that of the Sun, and may explain the composition of the oldest disk stars. A preliminary explanation of the origin of the superdisk is that the collapse of the protogalaxy was retarded or reversed by the pressure of trapped radiation. (auth)

7574 LIGHT CURVE OF HD 77581. Wickramsinghe, D. T.; Whelan, J. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 21P-25P(Apr 1974).

An analysis of the "ellipsoidal variable" type light curve of HD 77581, on the assumption of co-rotation, indicates that the primary must be nearly in contact with its Roche lobe. An orbital inclination $i \sim 90°$ and a mass ratio $q \sim 0.09$ give reasonable agreement with the light curve, mass function, and the x-ray eclipse duration. There is considerable evidence for gas streaming within the system and some evidence for a transient disc around the entire system. (auth)

7575 INFRARED PHOTOMETRY OF SOME OLD NOVAE. Feast, M. W.; Glass, I. S. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 81-85(Apr 1974).

J, H, K, L photometry is given for some old novae. The infrared colors of T CrB are normal for an M giant. The colors of RS Oph suggests high interstellar or circumstellar absorption. A cool

component is present in the system RT Ser (slow nova). RR Tel appears similar to RT Ser except that a cool shell is needed to explain the 3.4 to 20 μ results of Glass and Webster (Mon. Not. R. Astr. Soc.; 165: 77 (1973)). Some observations are given of V 1017 Ser, RR Pic, and V 603 Aql. (auth)

7576 ASTRONOMY AND EXTRATERRESTRIAL PHYSICS. Conference Held at Garching, Germany, March 6–9, 1974. Abstracts of papers. Weinheim, Ger.; Physik Verlag GmbH (1974). 67p. (In German and English). (CONF-740324-(Absts)).

7577 1968 TYPE II SUPERNOVA IN NGC 5236. Wood, R.; Andrews, P. J. (Radcliffe Observatory, Pretoria, South Afr.). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 13-29(Apr 1974).

The 1968 supernova in NGC 5236 was observed spectroscopically and photometrically with the Radcliffe reflector following its discovery by Pretoria amateur J. C. Bennett. UBV magnitudes were obtained on two dates one month apart. They allow modification of Wamsteker's results by making a more accurate correction for the background, and lead to light and color curves very similar to those for the 1969 supernova in NGC 1058, but different from those of the 1959 supernova in NGC 7331. The 15 spectrograms cover a period of 57 days and show the supernova to be typical of Type II. The spectral evolution and the redward drift of some features are discussed; in particular it is noted that the maximum at about 4600 Å drifts in a similar manner to the well-documented behavior of this feature in Type I spectra. One spectrogram, reduced to give the shape of the absolute energy distribution, indicates that the supernova resembled a blackbody at about 11000°K about a week after maximum light. The site of the supernova, superimposed on the nucleus of the galaxy, is unusual for its type. (auth)

7578 DISTORTION OF MAGNETIC STARS IN THEIR INFERRED MAGNETIC FIELDS. Monaghan, J. J. (Monash Univ., Clayton, Australia). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 163-168(Apr 1974).

The magnetic field of 53 Cam is analyzed by using a general expansion of an axisymmetric field and by allowing the star to be either spherical or nonspherical. The nonspherical model gives a marginally better fit. The results are consistent with an internal toroidal field much larger than the external poloidal field, and they suggest that future attempts at inferring the fields of magnetic stars should allow for a nonspherical surface. (auth)

7579 EFFECT OF MASS LOSS BY STELLAR WINDS ON THE PREMAIN SEQUENCE STAGE OF STELLAR EVOLUTION. Cuperman, S.; Sternlieb, A. (Tel Aviv Univ., Israel). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 183-187(Apr 1974).

Modified contraction times and total mass losses for some premain sequence stars which lose mass by stellar winds, have been calculated. In this, time varying rates of mass loss as deduced from the statistics of T-Tauri stars have been used. The results are compared with those corresponding to constant mass evolution. (auth)

7580 GRAVITY-DARKENING IN STARS FOR GENERAL ROTATION LAWS. Smith, R. C.; Worley, R. (Sussex Univ., Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 199-213(Apr 1974).

The von Zeipel gravity-darkening law holds strictly only for stars with a conservative rotation law and radiative atmospheres in which the transfer of energy is approximated by a diffusion equation. If the transfer equation is used, but meridional circulation is neglected, a perturbation treatment shows that the emergent flux satisfies $|F| \alpha g^{\frac{1}{2}}$ (where g is the effective gravity) for all conservative rotation laws. The inclusion of circulation, however, seems to restore von Zeipel's law, $|F| \alpha g$. For nonconservative rotation laws, $|F|$ is no longer a simple power of g, even assuming the diffusion equation. Two examples are given for circulation-free rotation laws, which show that the dependence of emergent flux on latitude can be quite strong. This could have important effects on close binary light curves. (auth)

7581 OPTICAL STABILITY OF X-PERSEI. Forhlich, A.; Nevo, I. (Tel Aviv Univ., Israel). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 221-226(Apr 1974).

The optical candidate for the X-ray source 2U 352 + 30, X-Per was observed photoelectrically four times during 1972 December. The average V magnitude was about 0.15 m larger than previously published values. The power spectra from two nights were featureless whereas on December 30 some low-amplitude low-frequency flickering was present, power of about 0.3 percent of the mean power at periods between 41 and 409 s. On December 28 large scale flickering was evident with about 2 percent of the mean optical power concentrated in oscillations having periods varying between 120 and 4 s. (auth)

7582 SLOWLY ROTATING HOMOGENEOUS MASSES IN GENERAL RELATIVITY. Chandrasekhar, S.; Miller, J. C. (Univ. of Chicago). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 63-79(Apr 1974).

A study is presented of slowly rotating homogeneous masses in which the energy density ϵ is a constant. The structure of such configurations is determined with the aid of equations derived by Hartle (Astrophys. J.; 150: 1005 (1967)) in the exact framework of general relativity. These configurations have a natural limit in that the static, nonrotating, configurations must have radii (R) exceeding 9/8 times the Schwarzschild radius (R_s). The derived structures, for varying R/R_s, are illustrated by a series of graphs. A result of particular interest which emerges is that the ellipticity of the configuration, for varying radius but constant mass and angular momentum, exhibits a very pronounced maximum at $R/R_s \sim 2.4$. (auth)

7583 EQUATION OF STATE OF ULTRADENSE RELATIVISTIC MATTER. Bludman, S. A. (Tel Aviv Univ., Israel). pp 372-385 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

Lectures are given on a question of principle and a practical question having to do with the equation of state $p = p(\varphi)$ of cold matter, of pressure p and mass density φ. A study is made of whether in a system of particles interacting in a Lorentz-invariant way the sound speed can exceed the speed of light. The role of the equation of state in determining the critical parameters, mass, and radius of neutron stars is studied. (JFP)

7584 RELATIVISTIC STARS, GRAVITATIONAL COLLAPSE, AND BLACK HOLES. Hartle, J. B. pp 153-195 of Relativity, Astrophysics, and Cosmology. Dordrecht, Netherlands; D. Reidel Publishing Co. (1973).

From proceedings of the summer school; Banff, Alberta (14 Aug 1972).

A review is given of the theory of the structure of relativistic stars and of the theory of the progress and outcome of gravitational collapse. It is shown that by computing the equation of state for matter in its ground state, solving the equations of hydrostatic equilibrium for the possible equilibrium configurations composed of this matter, and testing these equilibrium configurations for stability, the possible equilibrium end states of stellar evolution in the case of spherical geometry are white dwarfs and neutron stars. A study is then made of the basic features of spherically symmetric gravitational collapse, showing the end state of such a star evolution to be the formation of a black hole as a consequence of the formation of an event horizon. Some of the evidence for the inevitability of the event horizon in the case of nonspherical gravitational collapse is presented, and the types of black holes which can arise if this conjecture is correct are discussed. The properties of the two-parameter family of Kerr black holes are described, noting the failure to completely prove that the Kerr family of black holes are the unique black holes in Einstein's source-free general relativity. (IAA)

7585 PROPAGATION OF STRONG SHOCKS IN SELF-GRAVITATING, CONDUCTING GASES IN STELLAR MODELS. Verma, B. G.; Prasad, B. (Univ. of Gorakhpur, India). Acta Phys. Acad. Sci. Hung.; 34: No. 2-3, 239-248(1973).

Runge–Kutta method is applied to obtain a first-approximation solution to the problem of uniform propagation of strong shocks in self-gravitating conducting gases in stellar models. (auth)

7586 ORIGIN OF INTERSTELLAR MOLECULES. Dauvillier, A. (Observatoire du Pic du Midi, Bagneres, France). Bull. Soc. Roy. Sci. Liege; 42: No. 9-10, 413-416(1973). (In French).

After a chemical classification of interstellar molecules, it is shown that they can not originate at low temperature in a high vacuum and that they are pyrogenic products emitted by paleovulcanism in the absence of oxygen and evaporated from planetary surfaces during stellar evolution. As atoms and radicals are emitted from stars, these complex molecules are emitted from planets. They are not young but fossils. (tr-auth)

7587 POSSIBLE CONSEQUENCES OF NEARBY SUPERNOVA EXPLOSIONS FOR ATMOSPHERIC OZONE AND TERRESTRIAL LIFE. Ruderman, M. A. (Columbia Univ., New York). Science; 184: No. 4141, 1079-1081(7 Jun 1974).

Hard x-ray pulses or increased cosmic radiation originating in nearby supernova explosions may be capable of temporarily removing most of the Earth's atmospheric ozone cover even when direct radiation effects at the Earth's surface are negligible. Consequently, terrestrial life may be subject to relatively huge solar ultraviolet fluxes every few hundred million years. (auth)

7588 ANOMALOUS 1720-MHz OH EMISSION FROM V1057 CygNi. Lo, K.Y.; Bechis, K.P. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology). Astrophys. J. Lett. 185: No. 2, L71-L74 (15 Oct 1973).

We detected a new type of OH emission source from the V1057 Cyg star position. Only the 1720-MHz line is observable in emission. The line can be decomposed into two Gaussian components, each with a line width at half-power of about 0.3 km s^{-1}, separated by about 0.3 km s^{-1}. Both components are elliptically polarized. (auth)

7589 OBSERVATIONS OF SILICON MONOXIDE IN COOL STARS AT 4.05 MICRONS. Wollman, E.R.; Geballe, T.R.; Greenberg, L.T.; Holtz, J.Z. (Department of Physics, University of California, Berkeley); Rank, D.M. Astrophys. J. Lett. 184: No. 2, L85-L88 (1 Sept 1973).

Absorption due to the 3–1 vibration–rotation band head of $^{28}Si^{16}O$ at 2473 cm^{-1} has been detected in the atmospheres of a number of evolved giant and supergiant stars. The column density of $^{28}Si^{16}O$ in α Ori is determined to be $10^{21.7}$ cm^{-2}. None of the stars observed indicate measurable absorption due to the 2–0 band head of $^{30}Si^{16}O$ at 2467 cm^{-1}. A lower limit of 20 is established for the ratio $^{28}Si/^{30}Si$ in α Sco. (auth)

7590 HELIUM-3 IN IOTA ORIONIS B. Dworetsky, M.M. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. Lett. 184: No. 2, L75-L78 (1 Sept 1973).

The wavelength of He I λ6678, as measured on coudé spectrograms of ι Ori B (B2p, He-weak), indicates that the helium content of the star's atmosphere is dominated by ^3He. The observed isotope shift of $+0.42 \pm 0.11$ Å is similar to that found in 3 Cen A by Sargent and Jugaku. The two stars share several other spectroscopic anomalies; it is suggested that they constitute the first known members of a "new" class of peculiar early B stars. (auth)

7591 ORIGIN OF COSMIC RAYS, ATOMIC NUCLEI, AND PULSARS IN EXPLOSIONS OF MASSIVE STARS. Arnett, W.D.; Schramm, D.N. (Department of Astronomy and Physics, University of Texas at Austin). Astrophys. J. Lett. 184: No. 2, L47-L51 (1 Sept 1973).

Explosions of massive stars ($8 \leq M/M_\odot \leq 70$) are examined as the source of Galactic cosmic rays. Detailed nucleosynthetic and evolutionary calculations suggest that these massive stars produce the heavy elements ($Z \geq 6$) in their proper relative abundances. This is particularly significant because lower-mass stars (in particular the 4–8 $M_\odot$ range) are unable to produce the observed abundances of C and O relative to the iron peak. A small (~ 1.4 $M_\odot$) dense remnant star left after the explosion may provide a location for an electromagnetic acceleration mechanism. Those abundance ratios which can now be predicted (He, C, O, Ne, Mg) for the material to be accelerated by the pulsar give a reasonable match to the observed cosmic-ray data. The conditions at the outer edge of the remnant and the inner edge of the ejected material may be appropriate for an r-process to occur; the high-Z cosmic rays seem to show an enrichment of r-process material. It appears that these stars may be the astrophysical source for the Galactic cosmic rays. (auth)

7592 MASSIVE STARS AND INFRARED SOURCES. Hoyle, F.; Solomon, P.M.; Woolf, N.J. (University of Minnesota). Astrophys. J. Lett. 185: No. 2, L89-L93 (15 Oct 1973).

Stars of $\gtrsim 100$ $M_\odot$ are expected to pulsationally eject matter, and this mass loss camouflages the spectrum. For mass-loss rates greater than 3×10^{-5} $M_\odot Yr^{-1}$ the star ceases to have an H II region. And for higher rates the star becomes an infrared object. It is possible that the intrinsically most massive and luminous stars have not been singled out in external galaxies, because these stars would be dominantly emitting infrared radiation. (auth)

7593 CARBON MONOXIDE EMISSION FROM NEBULOSITY ASSOCIATED WITH HERBIG Be AND Ae TYPE STARS. Loren, R.B.; Bout, P.A.V.; Davis, J.H. (University of Texas at Austin). Astrophys. J. Lett. 185: No. 2, L67-L70 (15 Oct 1973).

Carbon monoxide emission in both the $^{12}C^{16}O$ and $^{13}C^{16}O$ J=1–0 lines has been observed from the regions near all the Be and Ae stars associated with nebulosity listed by Herbig. The emission intensity is peaked on the position of the star in all but a few cases. (auth)

7594 ON THE ISOTOPIC ABUNDANCES IN THE ORION NEBULA MOLECULAR CLOUD. Snyder, L.E. (Astronomy Department, University of Virginia, Charlottesville); Buhl, D. Astrophys. J. Lett. 185: No. 2, L79-L82 (15 Oct 1973).

High-resolution spectra of the J=1–0 transition of HCN have been obtained from the direction of the central region of the Orion Nebula molecular cloud in order to seek evidence of line saturation. It is concluded that this HCN profile is dominated by an unsaturated component. The resulting implications for the number ratio of HCN to DCN in the Orion Nebula are discussed. (auth)

7595 THE SPECTRA OF TWO WEAK-LINED B-TYPE SUPERGIANTS IN THE SMALL MAGELLANIC CLOUD. Osmer, P.S. (Cerro Tololo Inter-American Observatory). Astrophys. J. Lett. 184: No. 3, L127-L130 (15 Sept 1973).

Relative to stars of the same luminosity and temperature in the Galaxy and in the LMC, the SMC B1.5–B2.5 supergiants HD 5045 and HD 7099 show weak lines of N, O, Si, and probably Mg and C. The helium line strengths appear normal. Interpreted as an abundance effect, the line weakening implies a deficiency of at least a factor of 4 relative to the control stars. The stars are unlike the peculiar supergiants in the Galaxy observed by Walborn, which show deficiencies in only one or two elements. (auth)

7596 LINE IDENTIFICATIONS, ELEMENTAL ABUNDANCES, AND EQUIVALENT WIDTHS FOR 21 SHARP-LINED COOL PECULIAR A STARS AND TWO COMPARISON STANDARDS. Adelman, S.J. (Hale Observatories, California Institute of Technology, Carnegie Insitution of Washington). Astrophys. J. Suppl. Ser. 26: No. 226, 1-18 (Aug. 1973).

Line identifications, elemental abundances, and equivalent widths used in another study are given for 21 cool Ap stars and for two comparison standards. (auth)

7597 THEORETICAL ISOCHRONES FOR METAL-RICH GLOBULAR CLUSTERS. Hartwick, F.D.A.; Vanden Berg, D.A. (University of Victoria). Astrophys. J. 185: No. 3, 887-897 (1 Nov 1973).

Model evolutionary sequences have been obtained for the compositions $Y = 0.2, 0.3, 0.4$ at $Z = 10^{-2}$ for a range in masses around 1 $M_\odot$. The results are presented in the form of individual evolutionary tracks and isochrones. These new data have been combined with the most recent results of other workers for $Z = 10^{-3}$, to form analytical expressions relating isochrone turnoff luminosity, with age, helium abundance, and heavy-element abundance. Application of the results to the metal-rich globular clusters 47 Tuc and M71 yields ages which are ~40 percent lower than those found recently for the halo globular clusters. (auth)

7598 LOW-DISPERSION SPECTRA AND GALACTIC DISTRIBUTION OF VARIOUS INTERESTING STRONG-EMISSION-LINE OBJECTS IN THE SOUTHERN MILKY WAY. Sanduleak, N.; Stephenson, C.B. (Warner and Swasey Observatory, Case Western Reserve University). Astrophys. J. 185: No. 3, 899-913 (1 Nov 1973).

The entire southern Milky Way has been surveyed for various types of strong-emission-line objects on low-dispersion objective-prism plates taken mostly within a nine-month observing period in 1967–1968. This appears to be the first such comprehensive southern survey to utilize plates covering the entire λλ3300–6800 wavelength range. The spectra of 179 objects (including 20 apparently newly discovered emission-line objects) are classified into various major spectral categories recognizable at low dispersion. These include extreme Be-like objects, Z Andromedae-like stars, suspected very-low-excitation nebulae, peculiar M-type stars, VV Cephei stars, and very-steep-Balmer-decrement objects of unknown type. The galactic-longitude distributions of some of these types are discussed. (auth)

7599 THE GALACTIC SPACE FREQUENCY OF CLOSE BINARY SYSTEMS. Stothers, R. (Institute for Space Studies, Goddard Space Flight Center, NASA, New York City). Astrophys. J. 185: No. 3, 915-919 (1 Nov 1973).

An investigation of the galactic space frequency of close binary systems and other stars with high angular momentum is made on the basis of several criteria for the binary nature of a star. Within an accessible range of 3 kpc around the Sun, which includes parts of three spiral arms, there occurs no significant variation (to within a factor of about 2) in the space frequencies of B-type radial-velocity variables, M-type supergiants with blue companions, and Be stars. Implications of this result for the problems of the origin of close binary systems, the distribution of angular momentum in the Galaxy, and the relative numbers of blue and red supergiants are discussed. (auth)

7600 ROTATING NEUTRON STAR MODELS AND PULSARS. Börner, G.; Cohen, J.M. (Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 185: No. 3, 959-974 (1 Nov 1973).

Recently developed equations of state are used to construct fully relativistic models of rotating neutron stars. All of these stable neutron star models are bound. Consideration of binding energies suggests that very-low-mass neutron stars will not be formed in supernova explosions. Some criteria for equations of state are derived from a comparison with observations. Limits for the physical parameters of the Crab pulsar are obtained. In addition, we find that cosmic-ray protons cannot be produced by pulsars. (auth)

7601 ULTRAVIOLET PHOTOMETRY FROM THE ORBITING ASTRONOMICAL OBSERVATORY. IX. THE ULTRAVIOLET BEHAVIOR OF U OPHIUCHI. Eaton, J.A.; Ward, D.H. (Space Astronomy Laboratory, Washburn Observatory, Madison). Astrophys. J. 185: No. 3, 921-935 (1 Nov 1973).

Seven simultaneous light curves of U Oph have been obtained which cover a wavelength range from the blue part of the optical spectrum to just longward of Lα in the ultraviolet. An analysis of these curves has

been carried out to determine the spectral variation of limb and gravity darkening as well as to determine geometrical elements for the system. We conclude that (1) U Oph is gravity darkened to the extent expected from von Zeipel's law, (2) limb darkening increases toward shorter wavelengths, and (3) at the shortest wavelengths observed, the two stars are limb-darkened totally. (auth)

7602 THE NUCLEAR FUEL CONSUMPTION OF STARS. Hills, J.G.; Dale, T.M. (Department of Astronomy, University of Michigan). Astrophys. J. 185: No. 3, 937-943 (1 Nov 1973).

The amount of hydrogen fuel consumed by a star before its death is computed as a function of main-sequence mass, M, by using 46 color-magnitude diagrams of open clusters. Stars with $M \lesssim 6M_\odot$ are found to cease nuclear burning when they have built up a hydrogen-exhausted core with a mass $M_c \cong 0.70\ M_\odot$ which is approximately the mass of a white dwarf. Stars with $M > 6M_\odot$ from a hydrogen-exhausted core with $M_c > 0.70\ M_\odot$ while on the main sequence. This suggests that these stars may suffer considerable mass loss while on the main sequence after their core has reached $M_c \cong 0.70M_\odot$. If such mass loss occurs among the early B stars, it may explain the Be star phenomenon since it results in a shrinking of the central part of the star and an increase in its angular velocity which drives it toward rotational instability. (auth)

7603 OPTIMIZATION ANALYSIS OF THE LIGHT CURVES OF ECCENTRIC ECLIPSING BINARY SYSTEMS. Budding, E. (Manchester Univ. (UK)). Astrophys. Space Sci.; 26: No. 2, 371-385(Feb 1974).

The iterative optimization procedures described in a previous paper by the author have been extended to cover unrectified light curves of eccentric eclipsing binary systems. Two stars have been studied in detail: namely, Coronae Borealis and V477 Cygni. In both cases improved element sets have been obtained. Moreover, in the case of V477 Cygni the obtained values of the longitude of periastron for three different light curves are found to provide a useful basis for discussion of the apsidal motion of this system. (auth)

7604 NEUTRINO PAIR EMISSION BY A MAGNETIZED STELLAR PLASMA. Morgenstern Horing, N. J.; Acquista, C. (Stevens Inst. of Tech., Hoboken, N. J. (USA). Dept. of Physics). Astrophys. Space Sci.; 26: No. 2, 387-390(Feb 1974).

The decay of a plasmon into two neutrinos in the presence of an intense magnetic field has been studied by Canuto et al. (1970). They suggest that one of the principal longitudinal plasmon modes, which occurs only in magnetized plasmas, would cause certain magnetic stars to cool more rapidly than their unmagnetized counterparts. It is shown that this mechanism is inoperative since the plasmon mode involved cannot be excited in the direction parallel to the magnetic field as considered by Canuto et al. Moreover, for $\omega c/\omega p \ll 1$, it is shown that the other principal longitudinal plasmon mode considered earlier by Adams et al. (1963) (which is largely independent of the magnetic field) dominates the plasmon-neutrino decay cooling of magnetic stars. (auth)

7605 OFF-CENTER DETONATIONS IN EVOLVED STELLAR CORES. Buchler, J.-R. (Yeshiva Univ., New York (USA). Belfer Graduate School of Science); Wheeler, J. C. (Harvard Coll. Observatory, Cambridge, Mass. (USA)); Barkat, Z. K. (Hebrew Univ., Jerusalem (Israel). Dept. of Physics). Astrophys. Space Sci.; 26: No. 2, 391-401(Feb 1974).

Recent work on late stages of evolution has raised the possibility that the stars in the mass range from 4-8 $M_\odot$ may ignite carbon violently off-center. Hydrodynamic evolution has been carried out for models with various central densities and for temperature profiles both with and without an inversion. It has been found that, provided ignition leads to a detonation, both types of presupernova models have essentially the same final post detonation behavior. In particular, an off-center detonation is unable to prevent a complete disruption of the star if ignition occurs at low density. (auth)

7606 ABSOLUTE DIMENSIONS OF 140 CLOSE BINARY SYSTEMS. Giannone, P.; Giannuzzi, M. A. (Rome Univ. (Italy)). Astrophys. Space Sci.; 26: No. 2, 289-304(Feb 1974).

A continuous revision of the absolute dimensions of close binaries is necessary in order to improve the comparison between theory and observations and the study of the statistical properties of binary systems. The absolute dimensions of 140 close binaries have been computed. These systems have been extracted from recent catalogues of photometric and spectroscopic elements. (auth)

7607 ASYMPTOTIC FORMULATION OF A DIFFERENTIALLY ROTATING STAR WITH SMALL DISSIPATION. Sung, C.-H. (Chicago Univ., Ill. (USA)). Astrophys. Space Sci.; 26: No. 2, 305-317(Feb 1974).

A system of nonlinear differential equations is formulated for a differentially rotating star with a small radiative dissipation. Certain dimensionless parameters are introduced, such as ϵ_1 to indicate the degree of small, but not necessarily infinitesimal, departure from the steady, axisymmetric state, and ϵ_2 to indicate the localization of perturbations etc. As examples of application, the Goldreich-Schubert and the Solberg-Holland instabilities are discussed. (auth)

7608 EVOLUTION OF SUPERMASSIVE STARS WITH A STRONG MAGNETIC FIELD. Bisnovatyi-Kogan, G.S.; Blinnikov, S.I. (Institute of Applied Mathematics, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 3, 304-307 (Nov 1973).

An analysis is given of the evolution of a supermassive star with a poloidal magnetic field in the presence of pulsar-type radiation and angular-momentum loss. The magnetic energy of such a star should be less than 10^{-3} of the gravitational energy; otherwise the evolution time prior to loss of stability would be shorter than 10^5 yr, and it would no longer be possible to regard the supermassive star as a model for a quasar. (auth)

7609 SHELL NEBULAE AND WOLF-RAYET STARS: OBSERVATIONS OF NGC 2359. Lozinskaya, T.A. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 3, 317-319 (Nov 1973).

The nebula NGC 2359 has been observed in the Hα line with a high-contrast Fabry-Perot interferometer and a contact electronic image converter. The mean radial velocity relative to the Local Standard of Rest is $+52\pm5$ km/sec and the mean line half-width is 33 ± 3 km/sec for the diffuse part of the nebula; the relative velocities of large-scale internal motion there are less than 10 km/sec. A detailed survey of the filamentary shell around the star HD 56925 indicates that the Hα line reaches a width of 150-200 km/sec in the filaments. The filamentary shell is expanding at 55 ± 25 km/sec. These results are interpreted in terms of Pikel'ner and Shcheglov's and Avedisova's theories for the formation and evolution of shell nebulae around Wolf-Rayet stars. The power of the mass loss by the central star is $MV^2 = 10^{37}$ ergs/sec; the age of the shell nebula is about $5 \cdot 10^5$ yr. (auth)

7610 NARROW-BAND PHOTOELECTRIC PHOTOMETRY OF THE WOLF-RAYET ECLIPSING BINARY V444 CYGNI IN THE CONTINUUM ($\lambda\lambda$ 4244-7512 Å). Cherepashchuk, A.M.; Khaliullin, K.F. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 3, 330-335 (Nov 1973).

About 300-450 narrow-band ($\Delta\lambda \simeq 75$-165 Å) brightness measurements of V444 Cyg (WN 5+06) have been made during 1970-1971 in each of five regions of the continuum: $\lambda\lambda$4244, 4789, 5806, 6320, and 7512 Å. Wedge interference filters were used. It is shown empirically that the principal absorption mechanism in the WR envelope is free-electron scattering. The characteristic size of the WR envelope radiating in the continuum increases with λ, as does the relative luminosity of the WR component in the continuum. The physical continuum fluctuations of V444 Cyg are produced primarily in the space between the two components. (auth)

7611 VARIATIONS IN THE ABUNDANCE OF CHEMICAL ELEMENTS IN THE CLASSICAL CEPHEIDS OF OUR GALAXY. Yakimova, N.N. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 3, 336-341 (Nov 1973).

An analysis is made of Williams' estimates of the heavy-element (metals, CN) abundance in the envelopes of classical galactic Cepheids, based on narrow-band photoelectric photometry in Crawford's system. The brightness amplitude, color according to wide-band B, V photoelectric observations, and the author's previous meansize estimates are also considered for these Cepheids. Evidently as the height of a Cepheid above the galactic plane increases (especially in a given spiral arm), the heavy-element and helium abundances in its envelope diminish, its size becomes larger, the star becomes cooler at all phases of pulsation (particularly at maximum light), and the amplitude of its brightness variations diminishes. (auth)

7612 MASS OF STARS ON THE ASYMPTOTIC RED-GIANT BRANCH IN GLOBULAR CLUSTERS. Rusev, R.M. (Sofia University, Bulgaria). Sov. Astron.-AJ 17: No. 3, 342-345 (Nov 1973).

The mean masses of red-giant (RG) and asymptotic-branch (AGB) stars in globular clusters are compared by synthesizing a cluster from NGC 5466 and NGC 6397. A comparison of the ranges in density implies that $M^{AGB} \leq M^{RG}$. (auth)

7613 THE SYNTHESIS OF CLOSE-BINARY LIGHT CURVES. VI. X-RAY AND COLLAPSAR BINARIES. Hutchings, J.B. (Radcliffe Observatory, Pretoria, South Africa). Astrophys. J. 188: No. 2, 341-348 (1 Mar 1974).

General relations are presented for the interpretation of single distorted star light curves. These are then applied to five X-ray binaries (Cyg X-1, Her X-1, Vela X-1, SMC X-1, and 2U 1700-37). Together with considerations of X-ray and spectroscopic data, models and masses are derived for the systems. Similar considerations are applied to two non-X-ray binaries (HD 72754 and HD 187399) and suggest that massive collapsed stars are present in them. (auth)

7614 THE ASSOCIATION OF A HIGH-LUMINOSITY B STAR WITH 3U 1223—62. Vidal, N.V. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University). Astrophys. J. Lett. 186: No. 2, L81-L83 (1 Dec 1973).

Spectroscopic observations show that the star WRA 977 located at the northern corner of the error box of 3U 1223—62 is active on time scale of days and possibly hours. UBV photoelectric photometry reveals a high reddening value. Distance and absolute X-ray luminosity are discussed. (auth)

7615 RADIO-SYNTHESIS OBSERVATIONS OF PLANETARY NEBULAE. Terzian, Y. (National Astronomy and Ionosphere Center, Cornell University, Ithaca, New York); Balick, B.; Bignell, C. Astrophys. J. 188: No. 2, 257-277 (1 Mar 1974).

Continuum radio observations of planetary nebulae are presented with angular resolutions as small as $\sim 2''$. These observations were made at NRAO at 2.7 and 8.1 GHz with aperture-synthesis techniques. Detailed radio maps are presented for 14 nebulae and results of observations are also given for many others. Generally it is found that several nebulae show a "double-source" structure in addition to a normal thin shell. Substantial fine structure is observed on a scale of a few seconds of arc, and central brightness depressions are evident. Emission measures as high as 6.7×10^7 cm^{-6} pc are indicated. (auth)

7616 ON THE INTERPRETATION OF THE MAGNETIC CURVES OF THE Ap STARS AS DETERMINED BY THE PHOTOGRAPHIC TECHNIQUE. Borra, E.F. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 188: No. 2, 287-290 (1 Mar 1974).

Theoretical Zeeman-analyzed line profiles in magnetic stars have been computed for decentered dipole configurations of the magnetic field. It is found, on the basis of these profiles, that if the core of the lines are emphasized during the reduction of Zeeman-analyzed photographic plates, the longitudinal field obtained deviates from its true value. The deviations predicted are successful in producing the anharmonic variations observed in several Ap stars. (auth)

7617 REINVESTIGATION OF CERTAIN LONG-PERIOD A-TYPE BINARIES. Abt, H.A.; Levy, S.G. (Kitt Peak National Observatory, Tucson, Arizona). Astrophys. J. 188: No. 2, 291-294 (1 Mar 1974).

The published orbital elements of 16 normal late A-type stars have been reinvestigated with new radial velocities. For small-amplitude systems, we do not confirm the published orbital elements that were derived by combining velocities from various observatories. New or confirmed elements are given for several systems. There is no longer any convincing evidence for secondary stars (or black holes) having masses greater than those of their primaries. We continue to find no short-period (<300 days) binaries, such as are common among the Am stars, in this sample of normal late A-type stars, although a few nearly-contact systems outside this sample need further investigation. (auth)

7618 A LINE-BLANKETED MODEL STELLAR ATMOSPHERE OF SIRIUS. Fowler, J.W. (Astronomy Program, University of Maryland, College Park). Astrophys. J. 188: No. 2, 295-307 (1 Mar 1974).

The method of artificial absorption edges has been applied to a grid of model atmospheres to include the effects of hydrogen and metal line blanketing on the atmospheric structure. A best-fit model of Sirius is obtained which is free of the discrepancies inherent in unblanketed or partially blanketed models. All major spectral features calculated from the model agree with the corresponding observed features to within the observational uncertainty. Some additional properties of the models are discussed. (auth)

7619 TRANSFER OF RESONANCE-LINE RADIATION IN DIFFERENTIALLY EXPANDING ATMOSPHERES. III. FORMATION OF P CYGNI-TYPE LINES BY A DOUBLET LINE OR TWO PARTIALLY "BLENDED" LINES. Hewitt, T.G.; Noerdlinger, P.D. (Department of Astronomy, Michigan State University, East Lansing, Michigan 48823). Astrophys. J. 188: No. 2, 315-326 (1 Mar 1974).

We examine the transfer of resonance radiation in a spherically symmetric expanding stellar or quasi-stellar atmosphere in the case that the rest ("photospheric") position of one line (or line component) lies in the blueward absorption feature of another, under the simplifying assumptions of supersonic flow, atmosphere much larger than the central source, no occultation, no true absorption, and certain simplifications of the geometry. We find that for most optical depths and most reasonable choices of the velocity-radius relation, an emission peak is seen only for the redward component; only for small optical depths and wide doublet separation is a clear emission peak of the blue component formed within the absorption feature of the redward component. It is likewise difficult to find cases where between the rest locations of the two lines, the total light is less than that of the underlying continuum, unless the doublet separation exceeds approximately 0.4 of the total frequency spread of the absorption feature of either component. We have also treated cases where emission in the atmosphere is added to the scattered radiation. The effect is more to fill in the absorption features than to enhance the "emission" peaks. Using these results, we establish an upper limit to the N v optical depth in the expanding atmosphere of the QSO PHL 5200, and show that the outflowing stellar winds in several hot supergiants in Orion probably involve a more graduate acceleration and less mass loss than heretofore postulated. Gradual acceleration is also indicated in ζ Pup and ξ Per. (auth)

7620 THE OCCURRENCE OF A NONSPHERICAL THERMAL INSTABILITY IN RED GIANT STARS. Richstone, D.O. (Princeton University Observatory). Astrophys. J. 188: No. 2, 327-333 (1 Mar 1974).

The nonspherical thermal instability has been investigated for shell-burning stars, with special attention to the character of the problem at the boundaries of the shell. Approximate stability conditions are derived, and an analogy with the spherical instability (shell flash) is drawn. A number of models containing hydrogen- or helium-burning shells have been tested by numerical methods for stability against nonspherical thermal perturbations. Those models tested which were spherically stable have turned out to be also nonspherically stable. However, a sequence of models which are spherically unstable and represent the onset of a shell flash were found to be unstable in a number of nonspherical modes. (auth)

7621 ANALYTIC VARIATIONAL CALCULATION OF THE GROUND-STATE BINDING ENERGY OF HYDROGEN IN INTERMEDIATE AND INTENSE MAGNETIC FIELDS. Wilson, L.W. (Department of Physics, University of California, Berkeley, California 94720). Astrophys. J. 188: No. 2, 349-352 (1 Mar 1974).

A "prescription" of simple functions is given for an analytic variational calculation of the binding energy of the hydrogen ground state. The calculation still yields a relatively smooth transition between intermediate and intense fields. An explicit calculation of the binding energy as $B\to\infty$ is given. (auth)

7622 EMISSION LINES IN THE SPECTRUM OF ZETA OPHIUCHI. Niemelä, V.S. (Instituto de Astronomia y Fisica del Espacio, Buenos Aires, and Observatorio Astronomico, La Plata); Méndez, R.H. Astrophys. J. Lett. 187: No. 1, L23-L26 (1 Jan 1974).

Hα and He I λ15875 emissions and asymmetric profiles in the absorption lines have been discovered on recent spectra of ξ Oph. A description of the observations and a discussion of the possible interpretations are made. (auth)

7623 TWO NEW PHYSICAL PROCESSES IN THE FAR-ULTRAVIOLET SPECTRUM OF ZETA TAURI. Heap, S.R.; Stecher, T.P. (Laboratory for Optical Astronomy, Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. Lett. 187: No. 1, L27-L29 (1 Jan 1974).

We have detected absorption features in the far-ultraviolet spectrum of ξ Tau (B3pe), one of which corresponds to a new transition involving quasi-H^-, and the other to a transition involving quasi-H_2^+. The former transition produces a broad absorption feature on the red wing of Lα. It is the result of the absorption of a photon by a ground-state hydrogen atom and colliding electron, and it leads to the excitation of both electrons to the $2p^2\ {}^3P^e$ state of H^-. (auth)

7624 SHORT-TERM SPECTRAL VARIABILITY OF γ^2 VELORUM. PHOTOMETRIC OBSERVATIONS. Sanyal, A.; Weller, W.; Jeffers, S. (Centre for Research in Experimental Space Science and Physics Department, York University, Downsview, Ontario). Astrophys. J. Lett. 187: No. 1, L31-L33 (1 Jan 1974).

Photometric observations of γ^2 Vel using a narrow-band interference filter centered on He II λ4686 have been obtained. Analysis of these data shows short-period variability with a period of 154 ± 35 s. This is consistent with our previously reported spectrum-scanner observations showing short-term variability with a period of 200 ± 50 s. (auth)

7625 INTERSTELLAR CIRCULAR POLARIZATION: A REPORT OF EIGHT NEW POSITIVE RESULTS. Michalsky, J.J. Jr.; Swedlund, J.B.; Stokes, R.A.; Avery, R.W. (Battelle Observatory, Battelle-Northwest Laboratories, Richland, Washington 99352). Astrophys. J. Lett. 187: No. 1, L13-L14 (1 Jan 1974).

A survey for interstellar polarization effects carried out during 1973 March-September at Battelle Observatory has resulted in the discovery of circular polarization in the light of eight stars. We report the first detection of interstellar circular polarization in stars later than spectral class A and at least one exception to the usual wavelength dependence of the effect. (auth)

7626 BLACK HOLES IN BINARY SYSTEMS: INSTABILITY OF DISK ACCRETION. Lightman, A.P.; Eardley, D.M. (California Institute of Technology, Pasadena, California 91109). Astrophys. J. Lett. 187: No. 1, L1-L3 (1 Jan 1974).

We have tested the stability of a thin, orbiting accretion disk near a black hole. Under conditions appropriate for a binary X-ray source, with the usual (ad hoc) assumptions about viscosity, the disk is always secularly unstable on time scales of a few seconds or less. Therefore current thin-disk models for such X-ray sources are self-inconsistent. We

mention possibilities for alternative models; perhaps the secular instability explains chaotic time variations in Cygnus X-1. (auth)

7627 ON THE NATURE OF BD-10°4662. Zappala, R.R. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 187: No. 2, 257-259 (15 Jan 1974).

Infrared observations show that BD-10°4662 has excesses in the H-K and K-L colors similar to ordinary T Tauri stars. Emission at Ca II H and K confirms the close relationship to that group of objects. (auth)

7628 A NOTE ON THE USE OF THE STRENGTH OF THE Si II DOUBLET λλ6347, 6371 AS A LUMINOSITY INDICATOR IN B9-A2 SUPERGIANTS. Rosendhal, J.D. (Steward Observatory, University of Arizona, Tucson). Astrophys. J. 187: No. 2, 261-263 (15 Jan 1974).

Measurements of the strength of the red Si II lines λλ6347, 6371 indicate that among the B9-A2 supergiants there is a linear relation between absolute visual magnitude and line strength for stars more luminous than $M_v = -5$. Suitable calibration of this relationship should permit the determination of the absolute magnitude of individual B9-A2 supergiants to within ± 0.5 mag. (auth)

7629 THE VARIATIONS OF THE MAGNETIC Ap STAR 49 CAMELOPARDALIS. Bonsack, W.K.; Pilachowski, C.A.; Wolff, S.C. (Institute for Astronomy, University of Hawaii). Astrophys. J. 187: No. 2, 265-270 (15 Jan 1974).

The magnetic field of 49 Cam is found to vary cyclically between the limits of ± 1.7 kilogauss with a period of 4.d285. Central depths of lines of Fe, Cr, and several rare earths are found to vary synchronously, with maximum strength corresponding to magnetic maximum. The photometric variation patterns are complex, with double minima occurring in the b- and v-bands of the four-color uvby system. The minima coincide with the magnetic extrema, and one minimum can be accounted for by variable line-blocking in the filter band. The results are discussed in terms of the rigid-rotator model. (auth)

7630 THE ORIENTATION OF MAGNETIC AXES IN Ap STARS: AN ALTERNATIVE INTERPRETATION OF THE COMPONENT WITH SMALL OBLIQUITY. Borra, E.F. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 187: No. 2, 271-274 (15 Jan 1974).

Zeeman-analyzed line profiles have been computed for oblique-rotator models and decentered-dipole configurations of the magnetic-field geometry. It is argued on the basis of these profiles that periodic magnetic variables with nonreversing magnetic fields can be interpreted as having the magnetic axis nearly orthogonal to the rotation axis. These objects have been previously interpreted as having the magnetic and rotational axes nearly aligned. (auth)

7631 HIGHLY EXCITED STATES OF ATOMS IN A MAGNETIC FIELD. O'Connell, R.F. (Lawrence Livermore Laboratory, University of California, Livermore). Astrophys. J. 187: No. 2, 275-276 (15 Jan 1974).

The Zeeman effect in the Ba I absorption spectrum has been observed by Garton and Tomkins. One striking feature of the spectrum they obtained is the existence of a sequence of σ lines, extending across the zero-field series limit into the continuum, with a regular spacing of about $1.5\hbar\omega$, where ω is the cyclotron frequency. A semiclassical explanation is given for this result. (auth)

7632 LINES OF NEUTRAL BARIUM AND THE ABUNDANCE OF BARIUM IN TWO K SUPERGIANTS. Hyland, A.R.; Mould, J.R. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University). Astrophys. J. 187: No. 2, 277-281 (15 Jan 1974).

The abundance of barium in the late supergiants ϵ Peg and HR 4050 relative to the classical barium star HR 5058 is derived from the strengths of the weak Ba I lines, obtained from high-resolution echelle plates. Both stars are found to have essentially solar values of Ba/H and Ba/Fe. It is suggested that the observed strengths of the Ba II lines are due largely to their dependence on microturbulence and that reported overabundances based on these lines in ϵ Peg and other K supergiants are in error. (auth)

7633 FILAMENTARY STRUCTURE IN PLANETARY NEBULAE. Boeshaar, G.O. (Perkins Observatory, The Ohio State and Ohio Wesleyan Universities). Astrophys. J. 187: No. 2, 283-298 (15 Jan 1974).

Small-scale inhomogeneities in planetary nebulae were studied via photographic spectrophotometry in order to determine the characteristics of these features with respect to the ambient nebular gas. Untrailed spectrograms of eight planetaries yielded two types of data. First, relative intensity distributions along the projections of the spectrographic slit on the nebulae were produced to show the spatial variations in the emission from different atoms and ions. Then, relative emission-line fluxes were derived and used to find the electron temperatures and densities of filamentary regions and their surroundings. Compared with the ambient gas, the filamentary regions show strongly intensified emission for nebular transitions of neutral and singly ionized atoms, while auroral lines of these species along with lines of hydrogen and neutral helium have less striking enhancements. The strengths of lines from more highly ionized species exhibit little or no correlation with filamentary features. In addition, the filamentary zones are consistently cooler and denser than their surroundings. The above characteristics are in agreement with recent theoretical predictions for such structure. Previously encountered ambiguities in electron temperature and density measurements and in chemical abundance determinations seem explainable in terms of filamentary structure. Hence, caution must be used in dealing with photoelectric data which represents emission integrated over large nebular volumes. (auth)

7634 A PHOTONEUTRON MECHANISM FOR THE PRODUCTION OF TECHNETIUM-99 IN THE INTERIOR OF EVOLVED STARS. Edwards, T.W. (Department of Physics, University of Missouri—Columbia); Harrison, T.G. Astrophys. J. 187: No. 2, 313-319 (15 Jan 1974).

A photoneutron mechanism for the production of ^{99}Te and possibly other radioactive isotopes is considered. This process, herein called the Γ-process, operates coincidentally with the CNO cycle for hydrogen burning. In particular, it is shown that the photoneutron process involving $^{15}N(p,\lambda)^{16}O$; $^{100}Mo(\lambda,n)^{99}Mo(\beta^-)^{99}Tc$ is capable of generating ^{99}Te in amounts equivalent to that of the precursor material ^{100}Mo in a time comparable with the lifetime of ^{99}Te under equilibrium conditions only for (log T_6-0.076 log) $\geq$2.2 (auth)

7635 THE FORMATION OF DEUTERIUM AND THE LIGHT ELEMENTS BY SPALLATION IN SUPERNOVA SHOCKS. Colgate, S.A. (New Mexico Institute of Mining and Technology, Socorro). Astrophys. J. 187: No. 2, 321-332 (15 Jan 1974).

The propagation of the explosion shock wave of a supernova in the density gradient of the stellar envelope results in a shock of increasing strength. The acceleration of matter by the shock wave has previously been associated with the formation of cosmic rays and hence has emphasized the most dense possible conditions (compact stars) where the dynamic friction among the particles of the fluid is large and sufficient to prevent spallation. However, in the peculiar very low density conditions of a presumed red-giant envelope, a strong shock wave, $\sim$10 MeV per nucleon in 10^{-3} to 10^{-4} stellar mass fraction, can result in the nearly complete spallation of He plus heavies to free neutrons and protons. The spallation takes place in a high-temperature precursor of the shock wave (10-MeV ions and 0.5-MeV electrons) that cools by bremsstrahlung and Compton collisions in 50 to 100 nuclear collision periods. It is just the relative weakness of the radiation coupling that allows the precursor; but in turn once the photons have been created and thermalized, the equilibrium temperature behind the shock falls to less than 3×10^{9}°K in a time short enough that neutron capture on the protons is delayed until after equilibrium and so burning of deuterium (formed by neutron capture) does not take place. If $\sim$1 percent of the galactic matter has been processed through Type II supernovae, the deuterium production is adequate to remove the constraint of deuterium production from models of the early universe. The partial spallation of ^{13}C and ^{14}N will take place at lower energies and larger mass fractions and will result in the production of some of the light nuclei (^{7}Li, ^{10}B, ^{11}B) that are deficient in other production mechanisms. (auth)

7636 EARLY GAMMA RAYS FROM SUPERNOVAE. Colgate, S.A. (New Mexico Institute of Mining and Technology, Socorro). Astrophys. J. 187: No. 2, 333-335 (15 Jan 1974).

The recent λ-ray pulses observed from the Vela satellites are interpreted as λ-ray pulses from Type II hydrogen-spectrum supernovae in distant galaxies. The origin of the λ-rays is presumed to be the bremsstrahlung and inverse-Compton-heated photons originating from the high-ion-temperature shock precursor as it breaks through the surface of the presupernova star. The total energy released is predicted to be 10^{48} ergs, comparable to that which is consistent with the observed pulses from supernovae 10-30 Mpc distant.

7637 TYPE I SUPERNOVAE. Wheeler, J.C. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. 187: No. 2, 337-340 (15 Jan 1974).

Dynamical calculations of collapsing degenerate carbon cores give results which are quite similar to conditions found in Tycho's (1572) supernova, the prototypical Type I event. The models and their implications are discussed. (auth)

7638 LOW-TEMPERATURE PHOTONEUTRON SOURCES FOR STELLAR NEUCLEOSYNTHESIS. Harrison, T.G. (Departments of Nuclear Engineering and Physics, University of Missouri—Columbia); Edwards, T.W. Astrophys. J. 187: No. 2, 303-311 (15 Jan 1974).

This paper investigates a neutron-source mechanism for stellar nucleosynthesis which consists of (p,λ) reactions followed by (λ,n) reactions between various nuclei involved in the proton-proton and CNO-cycle hydrogen-burning processes. Several photoneutron cycles including $^{13}C(p,\lambda)^{14}N$ and $^{14}N(p,\lambda)^{15}O$ followed by $^{13}C(\lambda,n)^{12}C$ are shown to be active in CNO burning regions of stars both on and off the main sequence. In addition to these primary photoneutron sources, several other photoneutron-source mechanisms are also investigated but

are shown to be comparatively less active under similar environmental conditions. Although these cycles by themselves do not seem to produce sufficient neutrons for well-developed s-processing, similar mechanisms, such as $^{15}N[p,\lambda\ (12.7\ MeV)]^{16}O$ followed by (λ,n) and/or (λ,p) reactions, may be capable of synthesizing or destroying selected heavy nuclei perhaps not otherwise included in the s-process nucleosynthesis chain. (auth)

7639 SPECTROSCOPIC OBSERVATIONS OF HD 153919 (2U 1700–37). Wolff, S.C.; Morrison, N.D. (Institute of Astronomy, University of Hawaii). Astrophys. J. 187: No. 1, 69-72 (1 Jan 1974).

High-dispersion spectrograms are used to derive radial velocities and magnetic-field intensities for HD 153919, the optical counterpart of 2U 1700–37, and to determine its spectroscopic properties. The primary component of this binary system is of type O6.5f, with unusually strong emission of He II, C III, and N III. The Zeeman measurements set an upper limit of about 4000 gauss to the strength of the observable magnetic field. If the mass of the primary is normal, the minimum mass of the secondary is 1.4 $M_\odot$. (auth)

7640 INFRARED SPECTRA OF γ^2 VELORUM AND ζ PUPPIS. Barnes, T.G.; Lambert, D.L. (McDonald Observatory and Department of Astronomy, University of Texas at Austin); Potter, A.E. Astrophys. J. 187: No. 1, 73-82 (1 Jan 1974).

Observations of γ^2 Vel and ζ Pup are presented for the spectral region 5800–11,000 cm^{-1} (1.7–0.9μ), at resolutions of 2 and 4 cm^{-1}, respectively. This constitutes the first reported spectroscopy of a Wolf-Rayet star beyond 1.1 μ. The new spectral region contained numerous emission features for the WC8 component of γ^2 Vel, but only the Pβ line in absorption for the O4f star ζ Pup. Line identifications are given for γ^2 Vel and are shown to be consistent with visual spectroscopy. The species identified are H, He I–II, and C I–IV. In the spectral region 0.8–1.1 μ our identifications are in excellent accord with previous spectroscopy. However, after correcting the emission-line intensities for dilution by the O9 I component of γ^2 Vel, we find the lines to be 2–5 times stronger than the same lines in the WC7 star HD 192103, as given by Kuhi. This is attributed in part to a 1-μ excess in HD 192103 and in part to a lower excitation in γ^2 Vel. From the absence of He I λ 10830 in ζ Pup we are able to exclude the presence of an oft-conjectured WN companion. The blueshifted absorption component to He I λ10830 in γ^2 Vel and the line profile of the He II λ10,124 emission feature in ζ Pup are also discussed. (auth)

7641 AN INFRARED SOURCE ASSOCIATED WITH A HERBIG–HARO OBJECT. Strom, K.M.; Strom, S.E.; Grasdalen, G.L. (Kitt Peak National Observatory). Astrophys. J. 187: No. 1, 83-86 (1 Jan 1974).

An infrared source of angular extent $\lesssim 6''$ has been found associated with Herbig–Haro object in the Corona Austrina dark cloud. The infrared spectra of this object, between 5 and 12.6 μ, is very similar to that characterizing three irregular varibles of the Orion population located within the same dark cloud. It is proposed that the optical manifestation of this Herbig–Haro object represents the light scattered from a T Tauri–like star embedded deep within the CrA dark cloud. (auth)

7642 INTERPRETATION OF EPSILON AURIGAE. II. INFRARED EXCESS, SECONDARY LIGHT VARIATIONS, AND PLAUSIBLE FORMATION OF A PLANETARY SYSTEM. Huang, S. (Department of Astronomy, Northwestern University). Astrophys. J. 187: No. 1, 87-92 (1 Jan 1974).

Infrared excess based on the disk model proposed in a previous paper has been computed. It has been found that the disk alone will emit infrared radiation below the margin of detection. However, if individual condensations are present, the combined result of the disk proper and the condensations yields results of infrared excesses that are consistent with observations. The presence of condensations also makes the secondary light variation understandable. An elementary theory has been developed that analyzes such light variations. The result of the analysis yields the size of the orbit of the condensation around the secondary component. (auth)

7643 SPECTROSCOPIC COMPARISON OF OPEN CLUSTERS I. THE REDDENING, BLANKETING, AND METALLICITY OF M67. Barry, D.C. (Astronomy Department, University of Southern California); Cromwell, R.H. Astrophys. J. 187: No. 1, 107-115 (1 Jan 1974).

Equivalent widths are determined for 13 hydrogen and metallic features in the spectra of M67 dwarfs and subgiants using 1-mm widened image-tube spectrograms having 48 Å mm^{-1} disperison. These are directly compared with equivalent widths of the same features in F and G dwarfs in the Hyades and Coma clusters and nearby field dwarfs and subgiants. Assuming that equal hydrogen-line strengths indicate equal effective temperatures for dwarfs in the various clusters, relative metallicities, differential blanketing, and interstellar reddening values are determined. Comparisons with values available in the literature empirically establish the validity of the method. Eight equivalent-width ratios comparing metallic features in the M67 spectra to those in the Coma are in agreement with those comparing the mean of some nearby field stars to the Coma to within a rms scatter of only 2 1/2 percent. The averages of these eight ratios for the Hyades and the Coma dwarfs, while the metallicity of M67 dwarfs is only 14 percent greater. Thus the M67 dwarfs are not super-metal-rich. Examination of the present and previous reddening determinations for M67 leads to the adoption of E(B–V) =0.04 mag. Considering both the internal and systematic error, the estimated mean uncertainty in the color excess is about $\pm$0.01 mag. (auth)

7644 THE COMPOSITION AND EVOLUTIONARY STATUS OF THE HELIUM-RICH STARS. Osmer, P.S. (Cerro Tololo Inter-American Observatory); Peterson, D.M. Astrophys. J. 187: No. 1, 117-130 (1 Jan 1974).

A spectroscopic investigation of recently discovered helium-rich B-type stars shows that they form a well-defined group with the characteristics: (1) helium abundances comparable to hydrogen by number; (2) temperatures indicative of B0–B2 stars; (3) gravities appropriate to the zero-age main sequence; (4) generally low rotational velocities; (5) order-of-magnitude overabundances of oxygen and nitrogen; but (6) basically normal abundances of carbon, silicon, magnesium, and aluminum. The (g,Θ_{eff}) -diagram for these stars suggests that they are hot analogs of the Bp (helium-weak) stars. We argue that this is consistent with our understanding of mass-load and diffusion processes in this region of the H–R diagram. (auth)

7645 FOUR STELLAR-DIAMETER MEASUREMENTS BY A NEW TECHNIQUE: AMPLITUDE INTERFEROMETRY. Currie, D.G.; Knapp, S.L.; Liewer, K.M. (Department of Physics and Astronomy, University of Maryland, College Park). Astrophys. J. 187: No. 1, 131-134 (1 Jan 1974).

Diameters are reported for four late-type giant stars, α Boo, α Ori, α Tau, and β Peg. The diameters were obtained with a new kind of interferometer designed expressly to operate in the presence of atmospheric fluctuations. The new technique, called amplitude interferometry, is briefly described. The results include measurements of α Ori at several wavelengths. (auth)

7646 A COMPARISON OF THE STRAIGHT-MEAN, HARMONIC-MEAN AND MULTIPLE-PICKET APPROXIMATIONS FOR THE LINE OPACITIES IN COOL MODEL ATMOSPHERES. Carbon, D.F. (Kitt Peak National Observatory, Smithsonian Astrophysical Observatory, State University of New York at Stony Brook, and Harvard University). Astrophys. J. 187: No. 1, 135-145 (1 Jan 1974).

Three standard approximations—the straight mean, the harmonic mean, and the multiple picket—for the line opacity in a stellar atmosphere are compared in several numerical experiments. First, the approximations are used to determine the integrated fluxes and flux derivatives in two blanketed spectral intervals. While both the multiple picket and the straight mean adequately reproduce the monochromatically calculated flux derivatives in these intervals, only the multiple picket can reproduce the monochromatically calculated fluxes. Model atmospheres calculated with the straight mean and with the multiple picket are compared and found to differ significantly in their temperature structures. The models based on multiple pickets are found to be sensitive to changes in the turbulence parameter and the isotopic abundances. The limitations of the multiple-picket approximation are outlined. (auth)

7647 FORMATION OF THE LUMINOSITY-SENSITIVE O I MULTIPLET AT 7774 Å. Johnson, H.R. (Indiana University); Milkey, R.W.; Ramsey, L.W. Astrophys. J. 187: No. 1, 147-150 (1 Jan 1974).

We have calculated line profiles and equivalent widths for the 7774 Å multiplet of O I for model atmospheres in the range T_{eff}=6000°–6500°K for surface gravities in the range log g=4.0–1.0. A kinetic equilibrium (KE) treatment of line formation can partially account for the observed luminosity sensitivity of these lines and considerably modifies the derived microturbulent broadening parameter. Line porfiles obtained from KE line-formation theory are much deeper than LTE profiles, and we present new observations of Canopus (F0 Ib) to verify the essential correctness of our treatment. (auth)

7648 STELLAR MOLECULAR ABUDANCES. II. THE VIOLET DEPRESSION IN CARBON STARS. Hartmann, L.W.; Dolan, J.F. (Warner and Swasey Observatory, Case Western Reserve University, Cleveland, Ohio). Astrophys. J. 187: No. 1, 151-153 (1 Jan 1974).

The behavior of the theoretical abundance of the AlH molecule as a function of the C/O abundance ratio is not consistent with the suggestion that AlH is the source of the violet depression found in the continuous spectra of carbon stars. The results are consistent with the suggestion that a molecular species such as SiC is responsible. (auth)

7649 DESTRUCTION OF ^{14}N BY $^{14}N(e^-,\nu)^{14}C(\alpha,\gamma)^{18}O$ IN DEGENERATE MATTER. Mitalas, R. (Yale University Observatory). Astrophys. J. 187: No. 1, 155-158 (1 Jan 1974).

The destruction of ^{14}N by $^{14}N(e^-,\nu)^{14}C(\alpha,\gamma)^{18}O$ reactions in electron degenerate matter, where at densities $\sim 1\times10^6$ g cm^{-3} the electron Fermi energy is comparable to the ^{14}N electroncapture threshold energy of 156

keV, is investigated. The reaction is found to be unimportant in Population II red-giant interiors. (auth)

7650 THE TRANSFER OF CIRCULARLY POLARIZED RADIATION. Collins, G.W. II; Buerger, P.F. (Perkins Observatory, The Ohio State and Ohio Wesleyan Universities). Astrophys. J. 187: No. 1, 163-167 (1 Jan 1974).

The equations of radiative transfer for circularly polarized radiation arising through the mechanism proposed by Kemp are described. The method of solution, taking account of scattering processes, is based on the expansion of the source function in terms of moments of the radiation field. A comparison of numerical results with the observations of Grw+70°8247 yields a value for the average magnetic field in the atmosphere of this white dwarf star of 1.7×10^7 gauss. Discussion of the expected accuracy and applicability of the reuslts leads to the conclusion that the Kemp theory is not consistent with the observations. (auth)

7651 RELATIVISTIC TERMS IN NONLINEAR PULSATION THEORY. Davis, C.G. (Los Alamos Scientific Laboratory of the University of California, Los Alamos, New Mexico). Astrophys. J. 187: No. 1, 175-177 (1 Jan 1974).

The relativistic terms of radiation–transfer hydrodynamics have been included in the nonlinear equations of pulsation theory. Since there are large temperature gradients, due to shocks, observed in the atmospheres of pulsating stars, particularly W Virginis stars, we have included the velocity–dependent terms in the equations to account for the interaction of the material flow with the radiation field. The effect of these relativistic terms is studied in a model of W Virginis. (auth)

7652 ABSORPTION OF INFRARED RADIATION BY ELECTRONS IN THE FIELD OF A NEUTRAL HYDROGEN ATOM. Stallcop, J.R. (Ames Research Center, NASA, Moffett Field, California). Astrophys. J. 187: No. 1, 179-183 (1 Jan 1974).

The determination of the absorption of infrared radiation by free–free transitions of the negative hydrogen ion has been extended to higher temperatures. A simple analytical expression for the absorption coefficient has been derived; it is accurate for a wide range of high temperatures. (auth)

7653 A MODEL ENVELOPE FOR THE SHELL STAR 1 DELPHINI. Marlborough, J.M. (Department of Astronomy, University of Western Ontario, London, Ontario, Canada); Cowley, A.P. Astrophys. J. 187: No. 1, 99-106 (1 Jan 1974).

The stellar–wind model for the distribution of the ciurcumstellar material is shown to account satisfactorily for the appearance of the Hα line. The $N(\bar{\omega},z)$ and $v\bar{\omega}(\bar{\omega})$ distributions are similar to previous results for Pleione. The resulting steady–state rate of mass loss for 1 Del is 1.5×10^{-8} $M_\odot$ per year. The circumstellar envelope is shown to extend to at least 30 stellar radii and probably more than 100 stellar radii above the surface of the star. (auth)

7654 MULTIPOLE MAGNETIC FIELDS IN UPPER–MAIN–SEQUENCE STARS. Monaghan, J.J. (Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder). Astrophys. J. 186: No. 2, 631-642 (1 Dec 1973).

Models of uniformly rotating, axisymmetric, upper–main–sequence stars with multipole magnetic fields have been constructed using a perturbation method. The boundary conditions do not specify the solution uniquely. For one class of solutions the equations from a nonlinear eigenvalue problem which is solved for a special choice of the field stream function. The ratio of external to total magnetic flux is found to decrease with increasing rotation for a fixed surface field as it does for the dipole–like field. (auth)

7655 NEW C–S STARS AND OBSERVATIONS OF STRONG SPECTRAL VARIATIONS IN TWO CASES. Stephenson, C.B. (Warner and Swasey Observatory, Case Western Reserve University). Astrophys. J. 186: No. 2, 589-592 (1 Dec 1973).

A table lists some new southern C–S stars that I have identified as such from red–region objective–prism plates of the sort originally defining this natural spectral group. One known and one probable new member of the group, BH Cru and TT Cen, are reported to show strong spectral variations in the features which define membership in the C or S groups; TT Cen, in particular, has exhibited C_2 bands at one time and possible ZrO at another. (auth)

7656 COMMENTS ON NODAL QUENCHING AND ON CONVECTIVE QUENCHING IN RR LYRAE STARS. Tuggle, R.S.; Iben, I. Jr. (Massachusetts Institute of Technology and University of Illinois). Astrophys. J. 186: No. 2, 593-600 (1 Dec 1973).

Linear nonadiabatic pulsation theory has been used to examine recent hypotheses concerning a transition edge in the color–magnitude diagram for cluster variables. It is found that the occurrence of a transition edge cannot readily be interpreted in terms of a nodal quenching phenomenon as introduced by Cox and King and by Cox, Castor, and King. In a separate investigation it is shown that, when convective flux is treated in the manner of Baker and Kippenhahn and limited in the fashion suggested by Christy, envelope structure changes abruptly and stability against radial pulsation in the fundamental mode increases abruptly when surface temperature passes a critical, low value. Thereby strengthened is the suggestion that the red edge of the instability strip is due to the onset of strong convective currents in the hydrogen and helium ionization zones. (auth)

7657 STELLAR RATE FOR THE $^{16}O(p,\alpha)^{13}N$ REACTION. Woosley, S.E. (Rice University, Houston, Texas). Astrophys. J. 186: No. 2, 601-604 (1 Dec 1973).

Recent experimental determinations of the cross–section for the reaction $^{16}O(p,\alpha)^{13}N$ in an energy range of astrophysical interest now allow the accurate calculation of the reaction rate. The experimental data are summarized, and a fitted rate formula good for temperatures in the range $0.5\leq T_9\leq 6.0$ is given. (auth)

7658 STUDIES OF BETA CORONAE BOREALIS. II. IDENTIFICATION OF THE LANTHANIDES. Adelman, S.J. (NASA Goddard Space Flight Center, Greenbelt, Maryland); Shore, S.N.; Tiernan, M.F. Astrophys. J. 186: No. 2, 605-610 (1 Dec 1973).

Singly ionized and doubly ionized rare–earth line lists were compared with that of the peculiar star β CrB. Of those ions not previously identified, Ce III, Pr III, Sm III, Nd III, Ho II, and Yb II were definitely found. Implications of these identifications for the theories of Ap stars are discussed. (auth)

7659 ON THE INTERPRETATION OF THE SPECTRUM OF THE MASSIVE SPECTROSCOPIC BINARY HDE 228766. Walborn, N.R. (David Dunlap Observatory, University of Toronto, Richmond Hill, Ontario, Canada). Astrophys. J. 186: No. 2, 611-614 (1 Dec 1973).

The double–lined spectroscopic binary HDE 228766 is shown to consist of a very early Of star and a rapidly rotating, late O supergiant. As a consequence of this reinterpretation of the spectrum, an earlier conclusion that the emission–line star is much less massive than its companion requires reconsideration. (auth)

7660 THE COLOR OF BETA LYRAE IN 1958. Wood, D.B. (Goddard Space Flight Center). Astrophys. J. 186: No. 2, 615-616 (1 Dec 1973).

A redetermination of the photometric calibration used in the reduction of the 1958 Lick Observatory observations of β Lyr leads to a B–V color which is about 0.04 mag redder than originally published. The B—V color of β LYR in 1958 is thus, within the uncertainties of color transformation, the same as in 1959. (auth)

7661 SPECTROSCOPIC OBSERVATIONS OF SOME INFRARED OBJECTS. Wyckoff, S.; Wehinger, P. (Wise Observatory, Tel–Aviv University, Tel Aviv, Israel). Astrophys. J. 186: No. 2, 581-584 (1 Dec 1973).

Low–resolution (495 Å mm^{-1}) spectrograms covering the spectral region 5000–9000 Å are described for 13 infrared objects. Four of the objects which have not previously been observed are M–type stars, one of which may be a Mira variable and a member of the cluster NGC 2368. (auth)

7662 ONE–MICRON REGION SEARCH FOR HCN IN TWO CARBON STARS. Giguere, P.T. (Astronomy Department, University of Virginia, Charlottesville). Astrophys. J. 186: No. 2, 585-588 (1 Dec 1973).

New molecular constants have been used to predict wavelengths of heads of two 1–μ region HCN bands. We report a possible detection of the $3\nu_3$ band in UU Aur at 10,314 Å. (auth)

7663 H_2 QUADRUPOLE ROTATION–VIBRATION LINES IN INFRARED SPECTRA OF COOL STARS. Lambert, D.L.; Brooke, A.L.; Barnes, T.G. (McDonald Observatory and Department of Astronomy, University of Texas, Austin). Astrophys. J. 186: No. 2, 573-580 (1 Dec 1973).

The H_2 quadrupole rotation–vibration fundamental band has been searched for in high–resolution spectra of M giants and supergiants. H_2 has been identified in the spectrum of α Her (M5 II). Upper limits to the H_2 intensities are set for α Ori (M2 Iab), α Sco (M1–2 Iab) R Leo (M8 III), W Hya (M8e), and o Cet (M4 III–M7 III). These results are shown to be consistent with recent model–atmosphere predictions. Earlier identifications of 2–0 lines near 1 micron are reviewed, and alternative identifications for these stellar lines are presented. (auth)

7664 LABORATORY SIMULATION OF GRAPHITE FORMATION IN STELLAR ENVELOPES. Dorfeld, W.G.; Hudson, J.B. (Materials Division, Rensselaer Polytechnic Institute, Troy, New York). Astrophys. J. 186: No. 2, 715-724 (1 Dec 1973).

A technique has been developed which permits laboratory simulation of graphite condensation in the envelopes of cool, late sequence stars. Processes in the stellar envelope were simulated by allowing hydrogen–carbon mixtures of typical circumstellar composition and temperature to expand freely into vacuum, cooling and supersaturating the vapor. Expansion products were determined mass spectrometrically through the use of molecular beam techniques. The results of laboratory expansions were scaled to those occurring near M and N stars by comparing the number of collisional events in each case. Kinetic considerations indicate that the important rate process in rarefied envelopes will be C_2 formation; consequently scaling by termolecular

collisions was employed. Results of this study imply that envelope expansions near M giant contribute at most 10^{-2} of the observed interstellar grain density. In the case of pulsating N stars, on the other hand, the results are not inconsistent with previous predictions of essentially complete carbon condensation. (auth)

7665 MEASURES OF THE PHYSICAL PROPERTIES OF GLOBULAR-CLUSTER GIANTS. Osborn, W. (Yale University Observatory, New Haven, Connecticut). Astrophys. J. 186: No. 2, 725-740 (1 Dec 1973).

Red-giant-branch, red-horizontal-branch, and asymptotic-branch-stars in the five globular clusters M3, M5, M10, M13, and M92 have been observed with the David Dunlap Observatory (DDO) intermediate-band photometric system. The observed DDO colors have been used to derive the effective temperatures, surface gravities, and [Fe/H] values of the stars, and by combining these data with the cluster distance moduli, estimates of their masses have been obtained. The mean [Fe/H] values for the five clusters were found to be -1.01 for M3, -0.68 for M5, -1.44 for M10, -1.69 for M13, and -1.96 for M92. The derived masses of the asymptotic-branch and horizontal-branch stars are systematically smaller than the masses obtained for the red-giant-branch members. (auth)

7666 ABSOLUTE SPECTRAL ENERGY DISTRIBUTIONS FOR WHITE DWARFS. Oke, J.B. (Hale Observatories, California Institute of Technology, Carnegie Institution of Washington). Astrophys. J. Suppl. Ser. 27: No. 236, 21-35 (Feb 1974).

Absolute spectral energy distributions are presented for 38 white dwarfs of different spectral types. The wavelength range covered is approximately from λ3200 or λ3300 to somewhere between λ9500 and λ10,500. The bandpasses employed are in most cases 20-80 Å in the blue and 40-360 Å in the red and near-infrared. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 6639, 6737, 7574, 7588, 7613, 7614, 7639, 7748, 7812, 7827, and 7828.

7667 DISTANCE TO CYGNUS X-1. Margon, B. (Univ. of California, Berkeley); Bowyer, S.; Stone, R. P. S. Astrophys. J.; 185: No. 3, L113-L116(1 Nov 1973).

The extinction in the field immediately surrounding the x-ray source Cygnus X-1 was surveyed and a mean value $A_V/d = (1.3 \pm 0.2)$ kpc^{-1} was found for the 50 stars observed. Since $A_V = 3.3$ for HDE 226868, the visible component of the system, these data are incompatible with models in which the primary is a luminous, undermassive star at a distance less than 1 kpc. Uniform extrapolation of the reddening yields a distance estimate for Cygnus X-1 of (2.5 ± 0.4) kpc, in agreement with the spectroscopic modulus for an O9 star. Thus models that invoke a black hole for the collapsed secondary become more tenable. (auth)

7668 DISTANCE TO CYGNUS X-1 (HDE 226868). Bregman, J.; Butler, D.; Kemper, E.; Koski, A.; Kraft, R. P.; Stone, R. P. S. (Univ. of California, Santa Cruz). Astrophys. J.; 185: No. 3, L117-L120(1 Nov 1973).

From U, B, V photometry of 104 stars in a field of radius ~30′ centered on the x-ray binary star Cyg X-1 (HDE 226868), the color excess E(B-V) was studied as a function of distance. Spectral types were observed de novo for 42 of these stars. It was concluded that HDE 226868 cannot be nearer than 1 kpc, and is probably at a distance of 2.5 kpc or more. The primary component is therefore a luminous OB star of mass ~30 $M_\odot$, and the x-ray component has a minimum mass ~6 $M_\odot$. (auth)

7669 ABSORPTION AND EMISSION BY INTERSTELLAR CH AT 9 cm. Robinson, B. J.; Gardner, F. F.; Sinclair, M. W.; Whiteoak, J. B. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Nature (London); 248: No. 5443, 31-32(1 Mar 1974).

Observation of the 3335.475 MHz F = 1 → 1 transition of CH in several southern galactic sources is reported. In RCW 38 the line was seen in absorption, while the two satellite lines F = 0 → 1 and F = 1 → 0 were seen in emission. In several sources the distribution of CH was found to be extended. The observations were made in December 1973 using the Parkes 64m telescope equipped with a 9 cm parametric amplifier, and the receiver output was analyzed by a 512 channel digital correlator producing a spectral resolution of 19.5 kHz. Similar results were seen for RCW 36. These are stated to be the first instances found of absorption by CH. The pattern of main-line absorption and satellite-line emission indicates substantial departures from thermodynamic equilibrium in the population distribution. Comparisons are made with results for OH. (UK)

7670 UPPER LIMIT TO THE FLUX OF SOFT X RAYS FROM LAMBDA-SCO. Strong, K. T.; Colley, M. W.; Culhane, J. L. (University Coll., London). Nature (London); 248: No. 5443, 34-35(1 Mar 1974).

It is stated that during a rocket flight in May 1971, that carried a number of large area thin-window proportional counters, a soft x-ray source was observed in Scorpio (see Bleeker and others, Nature Phys. Sci. 241:55 (1973)). Photons in the energy range 0.37 to 1.9 keV were detected, and it was suggested that the bright star λ Sco may have been the source of the soft x-ray emission. This is a B1 V star and shows a varying radial velocity with a period of about 5.6 days; it has a visual magnitude of 1.62 and its distance is estimated as 100 pc. The identification of an object such as λ Sco as a soft x-ray emitter was considered to be of importance, and it was decided to analyze the data obtained with the MSSL low energy x-ray telescope. A thermal spectrum, with an electron temperature of 2×10^6K, was assumed in deriving an upper limit to the x-ray luminosity of the source. A 3σ upper limit of $4.0 \pm 1.0 \times 10^{32}$ ergs/sec was obtained for the source luminosity for the energy range 0.5 to 1.5 keV. Bleeker gave a value of 2×10^{33} ergs/sec, hence it would seem that the source they detected was not λ Sco. (UK)

7671 OBSERVATIONS OF Sgr A AT 160 MHz WITH 1.9 ARC MIN RESOLUTION. Dulk, G. A.; Slee, O. B. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Nature (London); 248: No. 5443, 33-34(1 Mar 1974).

It is stated that the radio source Sgr A, which is located at or near the galactic center, had been observed with high resolution (< 1 arc min.) at several frequencies between 327 and 15 GHz. The present communication extends high resolution observations down to 160 MHz, this being about the lowest frequency at which observations are possible since the exponential fall-off in flux makes the source undetectable below ~120 MHz. The 160 MHz observations were made using the radioheliograph at Culgoora, NSW, and the technique adopted is described in detail. The brightness distribution obtained is shown graphically. There appears to be a small compact source, possibly unresolved, apparently superimposed on an extended component about 8 arc min. in diameter. There have been previous reports of the splitting of the source into two subsources, Sgr A West and East, but no indications of this could be found in the present observations. The measured flux density of Sgr A at 160 MHz was found to be 114 ± 16 fu, this value including the contributions from both the extended and compact components. The flux density spectra, using results published to date, are discussed. (UK)

7672 ANALOGY BETWEEN NEUTRON STAR MODELS AND ISOTHERMAL GAS SPHERES AND THEIR GENERAL RELATIVISTIC INSTABILITY. Yabushita, S. (Kyoto Univ.). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 94-102(Apr 1974).

Investigation is made of the structure of gaseous spheres such that their equation of state is $p = q\rho$, where p and ρ are pressure and energy-density, respectively, and q is a constant, and the relation is obtained between the central density and the mass of the gaseous spheres such that they exert the same pressure at the boundary. It is shown that this relation is very similar to the corresponding one for neutron star models, and in particular there exist mass-peaks in the diagram. Assuming that the adiabatic index γ is related to q by the relation $\gamma = 1 + q$, equation for radial oscillation about equilibrium is derived. It is shown that the neutral mode of the oscillation can be expressed in terms of the Emden function. By making use of the neutral-mode solution, the degree of compression needed to make the sphere dynamically unstable is calculated. It can be shown that if $q \neq 0$ the sphere becomes unstable before the first mass-peak is reached in the mass-central density diagram, but if $q = 0$, the instability sets in precisely at the mass-peak. (auth)

7673 OPTICAL IDENTIFICATIONS FROM THE PARKES 2700 MHz SURVEY: THE 03^h, 19^h, AND 23^h ZONES, DECLINATIONS -33° TO -75°. Wall, J. V. (CSIRO, Epping, Australia); Cannon, R. D. Aust. J. Phys., Astrophys. Suppl.; No. 31, 1-40(Dec 1973).

Identifications are suggested for 105 radio sources in the third part of the Parkes 2700 MHz survey. The identifications, 63 with galaxies and 42 with quasistellar objects, were obtained from examination of V, B plate pairs taken with the Uppsala Schmidt telescope at Mount Stromlo Observatory. Additional position measurements with the Parkes 64 m telescope were made on 199 of the 459 catalogue sources covered by these plate pairs. Identification statistics for the area are compared with those of the first two parts of the Parkes 2700 MHz survey. (auth)

7674 STRUCTURE OF 194 SOUTHERN DECLINATION RADIO SOURCES FROM INTERPLANETARY SCINTILLATIONS. Bhandari, S. M. (Physical Research Lab., Ahmedabad, India);

Ananthakrishnan, S.; Rao, A. P. Aust. J. Phys.; 27: No. 1, 121-128(Feb 1974).

Interplanetary scintillation observations of 194 southern declination radio sources have been made at 327 MHz. The angular size and the fraction of the flux present in the scintillating component have been estimated. More than half of the observed sources scintillate and contain ≥ 10% of their flux in angular size smaller than 0.5". About 75% of the quasars and ~50% of the galaxies and the blank field objects scintillate. For quasars the spectral index seems to be correlated with the strength of scintillation; most of the flat spectrum quasars are strong scintillators and are unresolved. The scintillating properties of blank field objects are consistent with Bolton's hypothesis that most of these are galaxies beyond the plate limit of the Sky Survey. (auth)

7675 ABSORPTION OF RADIO WAVES IN THE GUM NEBULA. Cane, H. V. (Tasmania Univ., Sandy Bay, Australia). Proc. Astron. Soc. Aust.; 2: No. 4, 197-198(Oct 1973).

A 9 MHz survey covering declinations −30° to −53° and right ascentions 06^h30^m to 10^h00^m was made. Contours of relative brightness are shown. Obvious features are the unresolved supernova remnants Vela X and Puppis A. Comparison is made with other surveys. (AU)

7676 ABSORPTION OF HIGH ENERGY HEAVY NUCLEI AND γ RAYS AT SURFACE OF HOT NEUTRON STARS. Rengarajan, T. N. (Tata Inst. of Fundamental Research, Bombay). Nature (London); 248: No. 5449, 569-571(12 Apr 1974).

It is stated that although pulsars are potential sources of very high energy particles and γ rays it is not clear whether the radiation can escape from the pulsar environment and reach interstellar space. Various absorption processes can contribute to destruction of this radiation. Absorption of high energy γ rays by interactions with the radiation field of a pulsar may occur, and heavy nuclei may be destroyed by fragmentation in the high-density nebular matter surrounding early pulsars. It is here pointed out that high-energy heavy nuclei and γ rays may also be absorbed due to their interactions with blackbody photons emitted from the surface of hot neutron stars. There is a high density of photons close to a neutron star during its early stages, and it is during this period that pulsars lose most of their energy and accelerate particles to high energies. The absorption mechanism discussed extends to lower energies and is also independent of the magnetic field. (UK)

7677 STATISTICAL ANALYSIS OF CLOSE PAIRS OF QSOs. Burbidge, E. M.; Burbidge, G. R.; O'Dell, S. L. (Univ. of California, San Diego, La Jolla). Nature (London); 248: No. 5449, 568-569(12 Apr 1974).

Discussions of a statistical nature are presented in connection with the suggestion that the observation of close pairs of QSOs with very different redshifts is evidence supporting the non-cosmological redshift hypothesis Stockton, Nature Phys. Sci. 238: 37 (1972); Wampler and others, Nature 246: 203 (1973). This suggestion was criticized by Bahcall and Woltjer, Nature 247: 22 (1974) on statistical grounds. A statistical test is proposed. (UK)

7678 SUPER-RELATIVISTIC PHASE VELOCITIES OF RADIO SOURCE COMPONENTS. Sanders, R. H. (National Radio Astronomy Observatory, Green Bank, WV). Nature (London); 248: No. 5447, 390-392(29 Mar 1974).

It is stated that sudden injection of relativistic electrons at the centre of an extended dipolar magnetic field could lead to an apparent faster-than-light expansion of two synchrotron emitting regions. Subsequent injections of electrons would produce components which move outward along the same axis. (auth)

7679 SIXTH RADIO OUTBURST OF CYGNUS X-3. Marsh, R. A.; Purton, C. R.; Feldman, P. A. (York Univ., Toronto). Nature (London); 248: No. 5446, 319-320(22 Mar 1974).

The observations reported were made using the 46m telescope of the Algonquin Radio Observatory at 10.6 GHz in June and July 1973. The decay of this sixth radio outburst was exponential and similar to that of earlier outbursts. This finding is incompatible with source models involving simple adiabatic expansion, which predicts a power-law decay. An alternative model for the Cygnus X-3 radio source is here described. It is proposed that ambient gas affects the radiation from the synchrotron source in two ways: (1) a high-density gas occupies part of the path traversed by the synchrotron-emitting electrons, causing them to lose energy primarily by bremsstrahlung losses— this would explain the exponential decay; (2) each outburst is accompanied by an expanding cloud of ionized gas that surrounds the synchrotron source. (UK)

7680 INTERSTELLAR HYDROXYL AND WATER MASERS AND FORMALDEHYDE MASERS AND DASARS. Haar, D. T.; Pelling, M. A. (Oxford Univ., Cambridge, MA). Rep. Progr. Phys.; 37: No. 4, 481-561(1974).

In this paper, a review is given of the observational data on anomalous emission by OH, H_2O, and H_2CO molecules and on anomalous absorption by H_2CO molecules. Various theories advanced to account for this data are discussed and some models of a few particular sources are considered. (auth)

7681 SEARCH FOR CEN X-3. Perry, M. E.; Peterson, B. A.; Wickramasinghe, D. T.; Vidal, N. V. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 4, 188-190 (Oct 1973).

A search for the optical counterpart of Cen X-3 is described. Iris photometry was carried out on 13 good quality plates taken with the Uppsala Schmidt telescope at Mount Stromlo Observatory between 1957-62. Two stars were taken as references and the other stars taken relative to these. The values for the individual stars were summed on each plate and corrections were then applied to each plate to make this mean light curve constant, based on the assumption that most stars should not be variable. The primary of Cen X-3 is considered to be an early B giant or supergiant of $M_v = -4.5$. (AU)

7682 BLACK HOLES AND X-RAY BINARIES. Vidal, N. V.; Wickramasinghe, D. T.; Bessell, M. S.; Peterson, B. A. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 4, 190-191(Oct 1973).

The results are presented of an analysis of x-ray eclipse data and radial velocity curves of the x-ray sources 2U0900-40 and 2U1700-37, which indicate that both these systems have secondaries of mass greater than 2.7 $M_\odot$—the upper limit for the mass of a neutron star. It is pointed out that the compact nature of the secondary follows from the assumption that the x-ray mechanism is associated with mass transfer onto the primary. (AU)

7683 COLLAPSED OBJECTS AND GALACTIC X-RAY SOURCES. Peterson, B. A. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 4, 178-183(Oct 1973).

A discussion is given of the reasons for the existence of a critical mass that can be stable against gravitational collapse. This is followed with a discussion of x-ray production by a young neutron star, by a pulsar, and by a collapsed object accreting matter from the interstellar medium, or from a companion in a binary star system. (AU)

7684 PLASMA HYPOTHESIS FOR ANOMALOUS OH EMISSION. Melrose, D. B. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 4, 206-208(Oct 1973).

An alternative hypothesis to the maser theory of anomolous OH emission is presented. It is proposed that if in a particular region the plasma frequency were equal to the frequency of some molecular transition, then a nonthermal line emission could arise by resonant scattering of plasma waves by molecules. (AU)

7685 OBSERVATION OF Ne II IN THE COMPACT H II REGION G333.6−0.2. Aitken, D. K.; Jones, B. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 11P-15P (Apr 1974).

Observations of the spectrum of G333.6-0.2 between 8 μ and 13 μ show emission from the Ne II line at 12.80 μ. A neon abundance in the range 7.63 to 7.93 is found, in agreement with recent estimates of the cosmic abundance of neon. The continuum radiation is considered to be thermal emission from optically thin dust with extinction in a thicker cold dust envelope, both distributions containing silicates, and the optical depth of the dust in emission is consistent with the observed ratio infrared/Ly α excess. (auth)

7686 SIMPLE MODEL OF FLUCTUATIONS IN ACCRETION DISCS. Bath, G. T.; Evans, W. D.; Papoloizou, J. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 7P-9P(Apr 1974).

A relation between the period and lifetime of fluctuations in accretion discs is derived and compared with the observations of transient periodicities in x-ray sources and dwarf novae. (auth)

7687 ORIGIN OF THE MAGNETIC FIELD AND RELATIVISTIC PARTICLES IN THE CRAB NEBULA. Rees, M. J.; Gunn, J. E. (Sussex Univ., Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 1-12(Apr 1974).

The power from the Crab Pulsar NP 0531 probably emerges partly as 30 Hz waves and partly as a relativistic wind containing a toroidal magnetic field. A shock discontinuity is expected where the pressure of the relativistic outflow balances the pressure within the nebula. This shock would occur at a radius R_s which is about 10 percent of the total nebular radius R_{neb}. The relativistic particles and the magnetic flux would accumulate in the region $R_s < R < R_{neb}$. The magnetic field in this region would build up to equipartition strength, even if this field embodied only a few percent of the relativistic energy outflow from the pulsar. The 30 Hz waves would be absorbed at $R \simeq R_s$, their energy being

transferred to relativistic electrons. The continuum from the bulk of the nebula would then be entirely synchrotron radiation. The relevance of this model to various observed features of the Crab Nebula is briefly explored. (auth)

7688 SIMULTANEOUS OBSERVATIONS OF PULSAR INTENSITY VARIATIONS AT PARKES AND OOTACAMUND. Slee, O. B.; Ables, J. G.; Batchelor, R. A.; Krishna-Mohan, S.; Venugopal, V. R.; Swarup, G. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 31-47(Apr 1974).

Simultaneous observations at 326.5 MHz of the intensity variations of seven pulsars have been conducted over an 8000-km baseline between Australia and India. The theoretical interpretation of the drifting diffraction pattern is developed in some detail and a practical method is determined for measuring the velocity component along the baseline in the presence of intrinsic pulsar variability and random evolution of the pattern. It is shown that, because of the intrinsic variations, the usual method of determining velocity from the maximum cross-correlation leads to a large overestimate of the velocity. For the majority of the pulsars observed, the intensity fluctuations at the two stations were significantly decorrelated for all time shifts. It is concluded that the most likely reason for the decorrelation is the presence of a scale size approximately equal to the receiver separation of 8000 km. Three of the seven pulsars provided correlation functions which could be processed by the proposed method to give the velocity of pattern drift along the baseline. These velocities range from 40 km s^{-1} to 121 km s^{-1} and, if pattern velocity is indicative of pulsar velocity, are not high enough to place these pulsars in a class of particularly high-velocity objects. The pulsar PSR 1642-03 provided clear diffraction patterns whose direction of drift reversed in an interval of about 1 hr. This behavior is not consistent with a simple model of the interstellar electron irregularities but it may be possible to explain it with a multi-screen model. (auth)

7689 CONTROLLED VLF WAVE INJECTION EXPERIMENTS IN THE MAGNETOSPHERE. Helliwell, R. A. (Stanford Univ., CA). Space Sci. Rev.; 15: No. 6, 781-802(May 1974).

Whistler-mode waves injected into the magnetosphere from ground sources (e.g., lightning discharge, vlf transmitters) are used to probe the distribution of ions and electrons in the magnetosphere. They also cause wave growth (vlf emissions) and precipitation of electrons. Bursts of x-rays (>30 keV) and enhancements of D-region ionization are examples of precipitation effects caused by lightning-generated waves. Growing narrowband wave trains are triggered by manmade coherent waves. Growth rates of ~100 dB s^{-1} and total growths up to 30 dB have been measured using 5.5 kHz signals transmitted from Siple Station, Antarctica. Another source of coherent wave input to the magnetosphere are the harmonics from commercial power line systems. Power line harmonic radiation may suppress triggered emissions or change their frequency-time slope. Exponential growth of narrowband emissions is explained in terms of cyclotron resonance between the waves and trapped energetic electrons, with feedback included. Applications of wave injection experiments include: (1) study of emission mechanisms, (2) control of energetic particle precipitation, (3) diagnostics of cold and hot plasma, and (4) vlf communications. (auth)

7690 OPTICAL SATURATION. Selden, A. C. (Culham Lab., Abingdon, Eng.). Phys. Lett.; 47A: No. 5, 389-390(22 Apr 1974).

A general criterion is given for an amplifying medium to be self-saturating. The concept of self-saturation gain has application to laser physics, e.g., energy storage, and astrophysics (interstellar masers). Wide variations are shown to exist between different media. (auth)

7691 POINT CHARGE IN THE VICINITY OF A KERR BLACK HOLE. Cohen, J.M.; Kegeles, L.S. (Physics Department, University of Pennsylvania, Philadelphia, Pa. 19104); Vishveshwara, C.V.; Wald, R.M. Ann. Phys. (N.Y.) 82: No. 2, 597-603 (Feb 1974).

We derive the expression for the electromagnetic field of a point charge at rest on the symmetry axis near a rotating Kerr black hole. This is a generalization of the previously obtained solution for the field of a point charge near a nonrotating Schwarzschild black hole. Unlike the Schwarzschild case the charge is found to give rise to magnetic fields as seen by a stationary or locally nonrotating observer. (auth)

7692 GEDANKEN EXPERIMENTS TO DESTROY A BLACK HOLE. Wald, R. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Ann. Phys. (N.Y.) 82: No. 2, 548-556 (Feb 1974).

It is widely believed that the complete gravitational collapse of a body always results in a black hole (i.e., "naked sigularities" can never be produced) and that all black holes eventually "settled down" to Kerr-Newman solutions. An important feature of the Kerr-Newman black holes is that they satisfy relation $m^2 \geq a^2+e^2$ where m is the mass of the black hole, e is its charge, a=J/m is its angular momentum per unit mass and geometrized units G=c=1 are used. (For $m^2 < a^2+e^2$ the Kerr-Newman solutions describe naked singularities.) In this paper, we tested validity of the above conjectures on gravitational collapse by attemping to create a spacetime with $m^2 < a^2+e^2$ starting with a Kerr-Newman black hole with $m^2=a^2+e^2$. Such a spacetime would either have to be a new black hole solution or a "naked sigularity," in violation of the above conjectures. In the first gedanken experiment we attempt to make the black hole capture a test particle having large charge and orbital angular momentum compared with energy. In the second gedanken experiment we attempt to drop into the black hole a spinning test body having large spin to mass ratio. In both cases we find that bodies which would cause violation of $m^2 \geq a^2+e^2$ will not be captured by the black hole, and, thus, we cannot obtain $m^2 < a^2+e^2$, although we can come arbitrarily close in the sense that $m^2=a^2+e^2$ can be maintained in these processes. (auth)

7693 TWO-STATION OBSERVATIONS OF THE INTERSTELLAR SCINTILLATION FROM PULSARS. Rickett, B.J. (University of California, San Diego); Lang, K.R. Astrophys. J. 185: No. 3, 945-950 (1 Nov 1973).

The interstellar scintillations of three pulsars were observed at Owens Valley, California, and Arecibo, Puerto Rico, simultaneously at a frequency of 318 MHz. For PSR 1919+21 the records were decorrelated, implying a scintillation pattern scale smaller than the 5000-km baseline. For PSR 0834+06 and PSR 1133+16 the records were highly correlated with time offsets from 0 to 36 seconds. However, the offsets for PSR 1133+16 changed sign during the 4 days of observation, implying changes to the pattern drift velocity. An explanation for these changes is suggested in terms of changing refractive effects along the propagation path. (auth)

7694 PULSE EMISSION MECHANISMS IN PULSARS. Manchester, R.N.; Taderaru, E.; Taylor, J.H.; Huguenin, G.R. (Department of Physics and Astronomy, University of Massachusetts, Amherst). Astrophys. J. 185: No. 3, 951-957 (1 Nov 1973).

The widths of individual pulses and implied energy densities in the emission region are shown to be inconsistent with generation of pulsar emission near the velocity-of-light cylinder. The beaming of pulsar emission is therefore not due to relativistic corotation velocities but must be intrinsic to the source, and pulse emission regions are probably relatively close to the neutron star. (auth)

7695 OBSERVATIONS OF THE RECOMBINATION-LINE REGION TOWARD SAGITTARIUS A. Brown, R.L.; Balick, B. (National Radio Astronomy Observatory, Green Bank, West Virginia). Astrophys. J. 185: No. 3, 843-855 (1 Nov 1973).

In an investigation of the properties of the recombination-line region toward Sgr A a search was conducted at λ21 cm for the following lines: H166α, He166α, C166α, H208β, and He^+265α. Only the H166α line was detected, as this line had a peak antenna temperature of 0.43° K. The observational limits for the H208β line and the He166α line are consistent with a model in which the lines are emitted in the region having an electron temperature of 20° K and an electron density of 5 cm^{-3} and in which the ratio of ionized helium to hydrogen $n(He^+)/n(H^+) \lesssim 0.046$. Assuming that the total helium-to-hydrogen ratio is "normal," [He/H]=0.10, the observational $n(He^+)/n(H^+)$ ratio can be explained if either (1) the line-emitting region is ionized by a distribution of hot pre-white-dwarf stars (UV stars) having temperatures in the range $30{,}000° \lesssim T \lesssim 50{,}000°$K or (2) the rate for He^+ recombination via the radiative charge-transfer reaction $He^+ + H \rightarrow He + H^+ + h\nu$ exceeds the radiative recombination rate. These two interpretations are evaluated; the ionization rate and total cloud density that they require to explain the observational results are discussed. (auth)

7696 COLLISIONAL EXCITATION OF CARBON MONOXIDE BY H_2. Compaan, A.; Langer, W.D.; Eden, D.; Swinney, H.L. (Department of Physics, New York University). Astrophys. J. Lett. 185: No. 2, L105-L108 (15 Oct 1973).

We report here experimental values for the excitation cross-sections for H_2 on CO determined from our measurements (at 83° K) of the line widths of the pressure-broadened CO rotational Raman lines. High spectroscopic resolution was achieved by ganging an interferometer with a tandem-grating spectrometer. The cross sections $\sigma_{JJ'}$ deduced from a hard-sphere model for small J are typically 2×10^{-16} cm^2. (auth)

7697 OPTICAL OBSERVATIONS OF SANDULEAK 160. Petro, L.; Feldman, F.; Hiltner, W.A. (University of Michigan). Astrophys. J. Lett. 184: No. 3, L123-L126 (15 Sept 1973).

The variability of Sanduleak 160, the proposed optical counterpart of SMC X-1, has been confirmed. It shows a double-peaked optical variation with the minimum at X-ray eclipse being the deeper. The cos 2θ variation has a semiamplitude of 0.050 mag in the B filter, the cos θ variation has a semiamplitude of 0.025 mag, and there is a cos 3θ variation of 0.012 mag semiamplitude. From an analysis of the optical photometry and X-ray eclipse duration the mass ratio is found to be 0.28, i=79°, and P=3.89206 days. On the assumption that the mass of Sk 160 is 20 $M_\odot$, the mass of SMC X-1 is 5.6 $M_\odot$. (auth)

7698 MILLIMETER EMISSION LINES OF POLYATOMIC MOLECULES IN SAGITTARIUS B2. Solomon, P.M. (University of Minnesota); Penzias, A.A.; Jefferts, K.B.; Wilson, R.W. Astrophys. J. Lett. 185: No. 2, L63-L66 (15 Oct 1973).

We report the observation of emission from 13 rotational transitions of carbonyl sulfide (OCS), methyl cyanide (CH_3CN), isocyanic acid (HNCO), and cyanoacetylene (HC_3N), as well as from an intense unidentified line U81.5 in the Sgr B2 molecular cloud. Analysis of the data shows that the kinetic temperature in the cloud is about 100° K in the center. The rotational excitation temperature between levels in HNCO is only ~6° K, and the lines are shown to be optically thick. The proof of high optical depth in a line with subthermal emission indicates that the true abundance of HNCO and possibly many other molecules is much greater than has been previously estimated. (auth)

7699 NEW TRANSIENT SOURCE, CEPHEUS X-4, OBSERVED BY OSO-7. Ulmer, M.P.; Baity, W.A.; Wheaton, W.A.; Peterson, L.E. (University of California, San Diego). Astrophys. J. Lett. 184: No. 3, L117-L120 (15 Sept 1973).

A new, apparently transient, X-ray source, Cep X-4, was observed 1972 June 20–July 7 by the UCSD X-ray telescope on OSO-7. Subsequent observations by the lower-energy MIT X-ray telescope on the same satellite confirmed the source and provided an improved position of $\alpha = 21^h37^m$, $\sigma = 56'.78$ (1950 coordinates) with an error circle radius of ~0'.4. Best fits to the UCSD data in the 7–37 keV range were $6.5\times10^{-4}\ E^2\ (e^{E/1.9}-1)^{-1}$ and $8\times10^{-4}E^2(e^{E/4.2}-1)^{-1}$ photons $(cm^2\ s\ keV)^{-1}$ on 1972 June 20–28 and June 29–July 6, respectively. The source was undetected on two other occasions, with 2 σ upper limits being $\sim10^{-2}$ photons $(cm^2\ s)^{-1}$ for 1971 December 15–23 and 3×10^{-2} photons $(cm^2\ s)^{-1}$ for 1973 February 15–16 in the more sensitive 7–26 keV energy range. (auth)

7700 OPTICAL STUDIES OF UHURU SOURCES. VII. PHOTOELECTRIC PHOTOMETRY OF HD 77581=2U 0900-40. Jones, C.; Liller, W. (Harvard College Observatory, Cambridge, Massachusetts). Astrophys. J. Lett. 184: No. 3, L121-L122 (15 Sept 1973).

Photoelectric UBV observations of HD 77581, the sixth magnitude BO I star associated with 2U 0900-40, show that the star's brightness goes through a double cycle during the 8.95-day binary period found from X-ray observations. Our observations show that the cycles do not repeat exactly and that there is little change in color. (auth)

7701 OPTICAL STUDIES OF UHURU SOURCES. VI. PHOTOELECTRIC PHOTOMETRY OF HD 153919=2U 1700-37. Jones, C.; Liller, W. (Harvard College Observatory, Cambridge, Massachusetts). Astrophys. J. Lett. 184: No. 2, L65-L66 (1 Sept 1973).

Photoelectric observations of HD 153919, the optical candidate for the X-ray source 2U 1700-37, have revealed regular intensity variations with a period consistent with the 3.412-day X-ray period. The optical light curve shows two maxima and two minima every 3.4 days with a total visual amplitude of 0.08 mag. No changes in color were observed. (auth)

7702 OBSERVATIONS OF THE HIGHLY VARIABLE X-RAY SOURCE GX 339-4. Markert, T.H.; Canizares, C.R.; Clark, G.W.; Lewin, W.H.G.; Schnopper, H.W.; Sprott, G.F. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. Lett. 184: No. 2, L67-L70 (1 Sept 1973).

Observations with the MIT experiment on the OSO-7 have led to the discovery of an X-ray source, GX 339-4, which varies in intensity by at least a factor of 60 over hundreds of days but shows no evidence of periodic behavior or abrupt intensity changes on time scales from 3 minutes to 13 days. The observations show intense high states, low states with spectra consistent with increased absorption, and off states, when no statistically significant signal is observed. The behavior is unlike that of any previously reported X-ray source. (auth)

7703 THE EMISSION-LINE SPECTRUM OF THE VELA X SUPERNOVA REMNANT. Osterbrock, D.E.; Costero, R. (Washburn Observatory, University of Wisconsin-Madison). Astrophys. J. Lett. 184: No. 2, L71-L73 (1 Sept 1973).

Photoelectric spectrophotometric measurements of the bright filament A in Vela X are presented. The previously reported unusually large Hα/Hδ ratio is not confirmed. The observed spectrum deviates significantly from the spectra of H II regions and planetary nebulae, but agrees qualitatively with the predicted spectra of shock-wave supernova models, in particular with the Cox model with V=141 km s^{-1}. (auth)

7704 MAGNETIC OBSERVATIONS OF THE X-RAY BINARIES HD 77581 AND HD 153919. Angel, J.R.P.; McGraw, J.T. (Astronomy Department, University of Texas at Austin); Stockman, H.S. Jr. Astrophys. J. Lett. 184: No. 2, L79-L83 (1 Sept 1973).

Narrow-band circular polarization measurements made together with profile scans of Hα in HD 77581 and HD 153919 do not indicate significant Zeeman splitting. Individual measurements yield field values from 40 to 900 gauss, consistent with random errors expected from photon statistics assuming no magnetic field. Accurate measurements of the field in 53 Cam were obtained as a test of the measurement technique. (auth)

7705 AN X-RAY TELESCOPE SENSITIVE AT HIGH ENERGIES. Palmieri, T. M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Electronique Physique). Astrophys. Space Sci.; 26: No. 2, 431-445(Feb 1974).

A telescope is described which is capable of producing images of point sources of X-rays without recourse to reflection optics. A mathematical approach to the operation and to the signal-to-noise properties of the telescope is presented. This is followed by several examples of its response and a discussion of detectors that could be used with the device. (auth)

7706 OMNIDIRECTIONAL INDUCED COMPTON SCATTERING BY RELATIVISTIC ELECTRONS. Charugin, V. M.; Ochelkov, Yu. P. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij). Astrophys. Space Sci.; 26: No. 2, 337-344(Feb 1974).

Quasars, pulsars and other cosmic sources of intense radiation are known to have large brightness temperature ($kTb \gg mc^2$) and relativistic electron density values. In this case the induced Compton scattering by relativistic electrons should be considered. The probability of scattering with decreasing radiation frequency is derived for isotropic radiation scattering. When induced scattering takes place, the relativistic electron obtains its energy by transforming high-frequency quanta into the low-frequency ones. In the most intensive sources electrons would receive energies $E \sim mc^2 \times (kTb/mc^2)^{1/4}$ due to the heating rate proportional to E^{-5} with the cooling rate proportional to E^2. Considerable distortion of the quasar spectrum is possible for reasonably large values of relativistic electron density ($N \gtrsim 10^4\ cm^{-3}$) notwithstanding that the heating is negligible. In pulsars relativistic electron heating and spectrum distortion appear to depend more on the induced Compton scattering. (auth)

7707 RAYLEIGH-TAYLOR INSTABILITY OF A VISCOUS COMPRESSIBLE PLASMA OF VARIABLE DENSITY. Bhatia, P. K. (Jodhpur Univ. (India)). Astrophys. Space Sci.; 26: No. 2, 319-325(Feb 1974).

A study has been made of the problem of the Rayleigh-Taylor instability of a hydromagnetic plasma of varying density to investigate the influence of the simultaneous presence of the effects of compressibility and viscosity. The solution is shown to be characterized by a variational principle. Based on the variational principle proper solutions have been obtained for a semi-infinite plasma, in which the density has a one-dimensional gradient along the direction of a uniform vertical magnetic field, confined between two planes. Both the viscosity and magnetic field are found to have a stabilizing influence. The effect of compressibility is found to be destabilizing. (auth)

7708 SECULAR DECREASE IN FLUX OF SUPERNOVA REMNANTS CASSIOPEIA A AND SN-1572. Stankevich, K.S.; Ivanov, V.P.; Torkhov, V.A. (Scientific-Research Institute of Radiophysics, Gor'kii). Sov. Astron.-AJ 17: No. 3, 410-410 (Nov 1973).

The secular decrease in the flux of the supernovae Cassiopeia A, SN-1572, and Taurus A was studied at the wavelength λ=31.5 cm. It was found that the annual decrease in the flux is $0.85\pm0.05\%$ for Cassiopeia A, $0.8\pm0.1\%$ for SN-1572, and less than 0.2% for the Crab Nebula. (auth)

7709 INFRARED PUMPING OF MASER OH SOURCES ASSOCIATED WITH H II REGIONS. Burdyuzha, V.V.; Varshalovich, D.A. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 3, 308-313 (Nov 1973).

Recent observations indicate that the H II regions in which powerful maser OH sources occur are simultaneously strong sources of infrared radiation at $\lambda \simeq 50$–$100\ \mu$. A mechanism is here proposed for pumping the OH molecules in such sources by far-infrared radiation. As infrared radiation traverses the region containing OH molecules, its spectrum will be distorted, and in its interaction with the OH an effective transfer of population will take place between OH levels of different parity. The population of the upper Λ-doublet levels $F^v = 1^+,2^+$ of the ground state $J = 3/2\ (^2\Pi_{3/2})$ will become inverted relative to the lower levels $F^v = 1^-,2^-$, leading to maser amplification of the radio emission corresponding to the transitions between these sublevels. This pumping mechanism should prevail at least if $n_H \leq 3\cdot10^5\ cm^{-3}$. An analysis of the energy balance of the strongest OH subsource shows that its radio flux should be anisotropic, with $\Omega/4\pi = 10^{-2}$–10^{-4}. (auth)

7710 FREE PRECESSION AS AN EXPLANATION FOR THE 36-DAY PERIOD OF HERCULES X-1. Novikov, I.D. (Institute of Applied Mathematics, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 3, 295-296 (Nov 1973).

Arguments are given indicating that the 36-day period of Her X-1 results from the free precession of a neutron star which is slightly asymmetric. Accretion of material at the magnetic poles of a neutron star in a binary system can produce asymmetry and free precession of

the neutron star. In the case of single neutron-star pulsars, precession should generally be absent because the electromagnetic radiation will tend to bring the axis of inertia and the angular-momentnum vector of an oblate neutron star into alignment soon after it is formed. (auth)

7711 VARIABILITY OF HIGH-ENERGY GAMMA-RAY SOURCES. Vladimirskii, B.M.; Stepanyan, A.A.; Fomin, V.P. (Crimean Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 3, 289-290 (Nov 1973).

A report is given of 1971 observations of a high-energy γ-ray source previously discovered in Cygnus. The source was not detected in 1971 [amplitude (0.4 ± 0.4) %]. Since its intensity dropped by several times between October 1970 and April 1971, the Cygnus source is variable, as is a source in Cassiopeia. An analysis of available observations in the 10^{-8} and 10^{12}-eV energy ranges indicates that γ-ray sources may evidently be variable with a flare duration of no more than a few months. (auth)

7712 THE EFFECTS OF IONIZING RADIATION PRESSURE IN QUASARS AND X-RAY SOURCES. Tarter, C.B. (Lawrence Livermore Laboratory, University of California, Livermore); McKee, C.F. Astrophys. J. Lett. 186: No. 2, L63-L67 (1 Dec 1973).

Self-consistent calculations of the radiative acceleration in gases excited by power-law, bremsstrahlung, and blackbody ionizing sources are presented. The acceleration can be orders of magnitude greater than that due to Thomson scattering, which effectively reduces the Eddington limiting luminosity. The results are applied to current theoretical models for cosmic X-ray sources and for the line-producing regions of quasars. (auth)

7713 POSSIBLE DETECTION OF VERY SOFT x-RAYS FROM SS CYGNI. Rappaport, S.; Cash, W.; Doxsey, R.; McClintock, J.; Moore, G. (Physics Department and Center for Space Research, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Astrophys. J. Lett. 187: No. 1, L5-L7 (1 Jan 1974).

A new source of ultrasoft X-rays ($E < 1/4$keV) has been detected in the Cygnus region. The case is made for its identification with the close-binary variable SS Cygni, one of the brightest U Geminorum stars. The contribution of such stellar sources to the galactic component of the soft X-ray "background" is probably small. (auth)

7714 X-RAY EMISSION FROM AN INWARD-PROPAGATING SHOCK IN YOUNG SUPERNOVA REMNANTS. McKee, C.F. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. 188: No. 2, 335-339 (1 Mar 1974).

An inward-propagating shock wave is shown to accompany the deceleration of an ejected supernova shell by the ambient medium. The gas behind this shock can be a strong source of soft thermal X-rays. We demonstrate that equipartition between the electrons and ions behind the blast wave moving into the circumstellar medium results in high electron temperatures and the production of hard X-rays. This model is applied to the young supernova remnants that are known to be X-ray sources and is shown to account for most of the observed features of the X-ray spectrum of Cas A. (auth)

7715 PHYSICS OF COMPACT NONTHERMAL SOURCES. I. THEORY OF RADIATION PROCESSES. Jones, T.W.; O'Dell, S.L. (Department of Physics, University of California, San Diego, La Jolla, California 92037); Stein, W.A. Astrophys. J. 188: No. 2, 353-368 (1 Mar 1974).

The canonical nonthermal spectrum, taken to be incoherent electron-synchrotron radiation from a quasi-static source, i.e., one which does not vary radically over the observation period, is investigated allowing for the possibility of anisotropic electron distributions and highly ordered magnetic fields. From considerations of circular polarization, synchrotron self-absorption, self-Compton radiation, and Compton scattering off the microwave background, a system of restrictions upon the magnetic field and angular size of the source is parametrized in terms of the electron anisotropy and field geometry. The production and maintenance of small pitch angles for relativistic electrons is investigated. It is concluded that anisotropies visible in emission are difficult to achieve and maintain unless they result from relativistic hydrodynamical streaming. (auth)

7716 THE METHANOL SOURCE IN ORION AT 1.2 CENTIMETERS. Chui, M.F.; Cheung, A.C.; Matsakis, D.; Townes, C.H. (Department of Physics, University of California, Berkeley 94720 (415)642-1128); Cardiasmenos, A.G. Astrophys. J. Lett. 187: No. 1, L19-L21 (1 Jan 1974).

Methanol line radiation from Orion near 25 GHz has been reexamined and found to be much stronger than expected from earlier reports. The line widths are also narrower than other nonmasing molecular radiation. These results indicate either that there is more than one small source of methanol radiation in Orion, or that these transitions are inverted and varying with time. (auth)

7717 SPECTROSCOPIC OBSERVATIONS OF HZ HERCULIS. Crampton, D. (Dominion Astrophysical Observatory, Victoria, Canada). Astrophys. J. 187: No. 2, 345-348 (15 Jan 1974).

Spectroscopic observations of HZ Her obtained over a period of 1 year are presented. The velocity curve is distorted because of the shape of the star and the brightness distribution over its surface but preliminary estimates of the masses of HZ Her and the X-ray source are 2.2 ± 0.4 $M_\odot$ and 1.3 ± 0.4 $M_\odot$, respectively, assuming $i = 90°$. Apart from an absorption spectrum varying in type from BO to A8, only very weak variable emission at $\lambda\lambda$4602, 4640, and 4686 is observed. The space motion and distance of HZ Her are briefly discussed. (auth)

7718 DO COSMIC RAYS HEAT HZ HERCULIS? Brecher, K.; Morrison, P. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. 187: No. 2, 349-350 (15 Jan 1974).

It is suggested that the optical variability of HZ Her is due to surface heating produced by cosmic rays arising in the X-ray source Her X-1. Detection of π^0-decay gamma-rays from the system with a number flux $\phi\,(E_\gamma \gtrsim 50\ \text{MeV}) \gtrsim 10^{-7}\ \text{cm}^{-2}\ \text{s}^{-1}$ offers a test both of the proposed heating mechanism and of the existence of cosmic-ray proton sources outside the solar neighborhood. (auth)

7719 EXTENDED OBSERVATIONS OF > 7-keV X-RAYS FROM CENTAURUS X-3 BY THE OSO-7 SATELLITE. Baity, W.A.; Ulmer, M.P.; Wheaton, W.A.; Peterson, L.E. (University of California, San Diego). Astrophys. J. 187: No. 2, 341-344 (15 Jan 1974).

The UCSD X-ray telescope on board OSO-7 provided 43 days of continuous coverage of the variable X-ray source Cen X-3 at energies above 7 keV during 1971 December and 1972 January. We detected the 4.8-s pulsation period, the 2.087-day eclipse cycle, and an apparently nonperiodic, low-intensity state lasting more than 12 days. Spectra obtained over the 7-30 keV range during noneclipsed high-intensity states are steeper than those previously reported; typically the flux is $\sim E^{-2.0}$ or $E^{-1}\exp(-E/7\ \text{keV})$ photons $(\text{cm}^2\ \text{s}\ \text{keV})^{-1}$. Large changes, which may be characterized by a number spectral index α varying between 3.0 ± 0.2 and 2.0 ± 0.3, or by exponential spectra with kT varying from 6 ± 2 to 13 ± 3 keV, occur at different high-intensity states. (auth)

7720 A DETERMINATION OF THE COOLING TIME AND THE SPEED OF THE SURFACE CURRENTS OF HZ HERCULIS. Dahab, R.E. (Princeton University Observatory). Astrophys. J. 187: No. 2, 351-353 (15 Jan 1974).

A simple model has been used to compute the time for an element of the surface of HZ Herculis to cool once it is removed from the illumination of the X-ray source. This time turned out to be on the order of 10 seconds, i.e., extremely short compared with the orbital period. Additionally, estimates of the velocity and extent of currents due to the uneven heating of the stellar surface have been made. The results in orders of magnitude, are 4 km s^{-1} for the velocity and 40 km for the lateral extent. These numbers are too small to cause any likely observable effect. (auth)

7721 2U 1700-37: ANOTHER BLACK HOLE? Bessell, M.S.; Peterson, B.A.; Wickramasinghe, D.T.; Vidal, N.V. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University). Astrophys. J. 187: No. 2, 355-358 (15 Jan 1974).

Analyses of the reddening and interstellar features indicate that HD 153919, the primary star of the binary system containing 2U 1700—37, is a bright distant Of star. Comparison with the Of stars in Sco OB1 suggests a mass of 65 $M_\odot$ for HD 153919, which implies a mass of a about 2.7 $M_\odot$ for 2U 1700—37 from the solution of the radial-velocity curve. As this mass is greater than the probable upper limit for neutron stars, the X-ray source 2U 1700—37 could be another black hole. (auth)

7722 "LORENTZ FORCE-FREE" PULSAR ROTATING FIELDS. Endean, V.G. (Department of Engineering Science, University of Oxford, Oxford, England). Astrophys. J. 187: No. 2, 359-360 (15 Jan 1974).

It is shown that the "Lorentz force-free" rotating electromagnetic field problem may be reduced to an equation for the magnetic field of the form $(\nabla \times \mathbf{B}^*) \times \mathbf{B} = 0$, where $\mathbf{B}^*$ is related in a simple manner to B. Some implication of this new equation are discussed in the light of two special cases, details of which have already been published. (auth)

7723 NEUTRON STAR COREQUAKES AND CRUSTQUAKES. Heintzmann, H.; Hillebrandt, W.; Krotscheck, E. (Institut für theoretische Physik, D 5 Köln 41, Germany); Kundt, W. Ann. Phys. (N.Y.) 81: No. 2, 625-641 (Dec 1973).

A simple model for corequakes and crustquakes of neutron stars is developed which allows one to compute the (maximal possible) changes in the moments of inertia. Applied to recent semirealistic neutron star models, our results show that the large speed-ups observed twice in the Vela pulsar can (on inertial grounds) be related to both corequakes and crustquakes. The gravitational energy stored in the deformed core would be larger than the energy stored in the rotation of a young (10^3 to 10^4 years old) pulsar. (auth)

7724 SCORPIUS X-1: ORIGIN OF THE RADIO AND HARD X-RAY EMISSIONS. Ramaty, R.; Cheng, C.C. (NASA, Goddard Space Flight Center, Greenbelt, Maryland 20771); Tsuruta, S. Astrophys. J. 187: No. 1, 61-68 (1 Jan 1974).

The consequences of models for the central radio source and the hard X-ray (>30 keV) emitting region in Sco X-1 are examined. The radio emission could result from noncoherent synchrotron radiation, and the X-rays may be produced by bremsstrahlung. We show that both these mechanisms require a mass outflow from Sco X-1. The radio source is located at $r \simeq 3\times10^{12}$ cm from the center of the star, and its linear dimensions do not exceed 3×10^{12} cm. The magnetic field in the radio source is on the order of 1 gauss. If the hard X-rays are produced by thermal bremsstrahlung, their source is located at $10^9 \lesssim r \lesssim 5\times10^9$ cm, the temperature is 2×10^9 °K, and the emission measure is 2×10^{56} cm^{-3}. This hot plasma loses energy inward by conduction and outward by supersonic expansion. The rates of energy loss for both of these processes are about 10^{36} ergs s^{-1}, comparable to the total luminosity of Sco X-1. The outward mass flow has the following consequences: It maintains the magnetic field in the radio source which would otherwise fall off as r^{-3} and could not account for the radio emission. It ionizes the interstellar medium in the vicinity of Sco X-1, thereby producing H β emission consistent with observations. The lower limit on the energy deposited by charged particles in the vicinity of Sco X-1, as obtained from the observed Hβ emission, is about 3×10^{35} ergs s^{-1}. The mass loss of Sco X-1 is $\sim 3\times10^{-8}$ $M_\odot$ per year. (auth)

7725 THE THIRD UHURU CATALOG OF X-RAY SOURCES. Giacconi, R.; Murray, S.; Gursky, H.; Kellogg, E.; Schreier, E.; Matilsky, T.; Koch, D.; Tananbaum, H. (American Science & Engineering, Inc., Cambridge, Massachussetts 02139). Astrophys. J. Suppl. Ser. 27: 37-64 (Feb 1974).

A new edition of the catalog of X-ray sources observed with Uhuru is presented. About 125 days of data have been analyzed for the 3U catalog, yielding a total of 161 X-ray sources. The distribution of sources is similar to that obtained for earlier editions of this catalog. Location error regions for many of the sources previously listed in the 2U catalog have been significantly reduced in size. (auth)

7726 FLUX-DENSITY-SPECTRAL-INDEX RELATION OF EXTRAGALACTIC RADIO SOURCES. Petrosian, V. (Institute for Plasma Research and Department of Applied Physics, Stanford University); Dickey, J. Astrophys. J. 186: No. 2, 403-420 (1 Dec 1973).

We have analyzed the spectral-index distribution of extragalactic radio sources and its variation with flux density and survey frequency. We find that the effect of K-correction on this variation (which if observed could imply that these sources are at cosmological distances) is small compared with observational uncertainties and other effects. We also derive a form for the intrinsic spectral distribution (assuming it to be independent of redshift and luminosity) which consists of two Gaussians with median spectral indices of ~0.8 and 0.4 and with dispersion of 0.25 and 0.4, respectively. The first class of sources is found in low-frequency surveys. The second class, consisting of only a few percent of all sources, appears in high-frequency surveys and has spectra-index distributions similar to sources identified with quasars. (auth)

7727 A PROLONGED INJECTION MODEL FOR VARIABLE RADIO SOURCES. Peterson, F.W.; Dent, W.A. (Department of Physics and Astronomy, University of Massachusetts, Amherst). Astrophys. J. 186: No. 2, 421-432 (1 Dec 1973).

Three forms of an injection-expansion model for variable radio sources are considered. The model is used to explain the 1966-1967 radio outburst in 3C 273, and the data in turn lead to a preferred form for the injection rate. The model is shown to be consistent with its assumption of adiabatic expansion. (auth)

7728 INTERSTELLAR AMMONIA. Morris, M. (University of Chicago); Zuckerman, B.; Palmer, P.; Turner, B.E. Astrophys. J. 186: No. 2, 501-528 (1 Dec 1973).

Microwave inversion radiation from one or more of the metastable rotational levels of ammonia (NH_3) has been observed in several galactic objects including W3(OH), Orion A, W43, W51, DR-21(OH), and five sources in the galactic center region (including two previously known). The NH_3 emission is extended in most of these sources. NH_3 has also been tentatively detected in cloud 4, a dark dust cloud, implying a lower limit of 5×10^3 cm^{-3} to the particle density in this source. The relative antenna temperatures of lines from the (J,K) = (1,1), (2,2), and (3,3) rotational levels in four sources indicate that the excitation is not adequately explained by thermalization at a single temperature. Several possible explanations are discussed, including the effects of a core-halo structure for the sources, and an anomalous ortho/para NH_3 abundance ratio. We have also investigated radiation from the nonmetastable (2,1) level in Sgr B2. An angular area of 5.2 ± 1.5 square arc minutes was found for this source. If the average H_2 density is 10^6 cm^{-3} in a spherical source of this projected size at the distance of the galactic center, the total mass would be 10^7 $M_\odot$. The density of particles required to collisionally populate the upper levels of the metastable inversion doublets so that emission lines can be seen above the continuum background is estimated to be $\geq 10^4$ cm^{-3}. Ammonia was detected in 11 out of 20 sources searched to a limit of ~0.25°K, indicating that it is a fairly widespread molecule in the interstellar medium and that these relatively high density conditions are quite common in the Galaxy. A search for the molecule PN was unsuccessful. This may have significant implications about the dominant form assumed by nitrogen in dark interstellar clouds. (auth)

7729 W3(OH): ACCURATE RELATIVE POSITIONS OF WATER-VAPOR EMISSION FEATURES. Reisz, A.C.; Shapiro, I.I. (Department of Earth and Planetary Science, Massachusetts Institute of Technology); Moran, J.M.; Papadopoulos, G.D.; Burke, B.F.; Lo, K.Y.; Schwartz, P.R. Astrophys. J. 186: No. 2, 537-544 (1 Dec 1973).

Very-long-baseline interferometric observations made on 1971 March 28 were used to determine the relative angular positions of water-vapor emission features in the radio source W3(OH) to within 0."0003 through combined use of fringe-rate and fringe-phase information. Observations on the longest available Earth-based interferometer baselines should yield more than an order of magnitude greater accuracy and would be sensitive, within a year, to transverse (proper) motions of about 1 km s^{-1} between features at the 2.5 kpc distance of W3(OH). (auth)

7730 MICROWAVE SPECTROSCOPIC MAPPING OF GASEOUS NEBULAE. III. HYDROGEN, HELIUM, AND CARBON IN ORION A. Chaisson, E.J. (Center for Astrophysics, Smithsonian Astrophysical Observatory, and Harvard College Observatory, Cambridge, Massachusetts). Astrophys. J. 186: No. 2, 545-554 (1 Dec 1973).

Recombination lines of hydrogen and helium have been detected at five locations distributed throughout the interior portion or Ori A. The average values of ~9200°K for the temperature and of Ori A. The relative ionized helium abundance are essentially constant throughout the region mapped. Carbon recombination lines that are thought to originate in a partially ionized region have also been mapped at five locations. Carbon-line emission is found to be most intense near the dark dust lane toward the northeast. (auth)

7731 MICROWAVE SPECTROSCOPIC MAPPING OF GASEOUS NEBULAE. IV. EXCITED HYDROGEN IN SAGITTARIUS B2. Chaisson, E.J. (Center for Astrophysics, Smithsonian Astrophysical Observatory and Harvard College Observatory, Cambridge, Massachusetts). Astrophys. J. 186: No. 2, 555-572 (1 Dec 1973).

Of the many molecular clouds that reside near the galactic center, only the Sgr B2 complex is apparently associated with an H II region. Observations of the H 92α radio recombination line are presented for many locations distributed across the massive Sgr B2 nebula. The distribution of nebular radial velocities is shown to mimic that of the H_2CO molecule; the orientation of each axis of apparent rotation and the comparison of the velocity gradients strongly suggest that the H_2CO cloud is physically associated with the Sgr B2 nebula and that the two regions dynamically move as a cohesive unit. The width of the recombination line increases with distance r (arc min) from the nebular center. The line-broadening mechanisms of thermal, turbulent, rotational, expansive (contractive), and electron collisional motions are examined; the observed widths are consistent with supersonic turbulence that obeys the relation $\langle v_t^2(r) \rangle^{1/2} = 21.5$ km s^{-1} (1+0.26r). Observations of the H 92α line are supplemented with several measurements of previously unpublished recombination lines observed at a variety of frequencies. A non-LTE solution yields $\langle T_e \rangle = 10^{4}$°K, $\langle N_e \rangle = 10^{4.1}$ cm^{-3}, and $\langle EM \rangle = 10^{7.1}$ pc cm^{-6}. A small but significant departure of line width from the relation of pure Doppler broadening is shown to be an effect of antenna beamwidth; there is no evidence for impact broadening. The failure to find the He 92α line sets an upper limit for the ratio $n(He^+)/n(H^+) < 0.02$ and adds to the growing anomaly concerning the apparent lack of helium at the center of the Galaxy. (auth)

7732 COLOR PHOTOMETRIC STUDY OF HZ HERCULIS. Boynton, P.E.; Canterna, R.; Crosa, L.; Deeter, J.; Gerend, D. (Department of Astronomy, University of Washington, Seattle). Astrophys. J. 186: No. 2, 617-624 (1 Dec 1973).

Standard four color UBVr photoelectric observations of the X-ray binary HZ Her/Her X-1 are studied for 35-day variations and for possible identification of several optical components within this system through their color signature in the composite light curve. The results of our analysis indicate three distinct luminous elements in the system: a relatively cool presumably stellar member discernible only at minimum light, a hotter second component which exhibits 1.7-day eclipse cycle and is responsible for the major portion of optical luminosity, and finally very hot component whose prominence in the light curve appears strongly correlated with the 35-day X-ray periodicity. (auth)

7733 ALGORITHM FOR SOLVING THE NONLINEAR PULSAR EQUATION. Ingraham, R.L. (Research Center, New Mexico State University, Las Cruces, New Mexico). Astrophys. J. 186: No. 2, 625-630 (1 Dec 1973).

A single quasilinear second-order partial differential equation

quantitatively describing the electrodynamics of an axisymmetric pulsar magnetosphere has recently been independently developed by several people. The solution involves specifying an unknown function F(A) of the toroidal component A of the magnetic vector potential. Some reasons for rejecting the linear case dF/dA = (piecewise) const. are given. We present a set of boundary conditions and an algorithm for solving this very unstraightforward and singular nonlinear problem in the whole magnetosphere which is expected on physical grounds to yield a C^1 solution for A and F(A) (perhaps not unique). The asymptotic equation (polar radius $\to\infty$) is discussed in detail; in particular we show that any solution of it automatically satisfies the nontrivial constraint: particle velocities $\leq c$. (auth)

7734 A MODEL FOR THE LIGHT CURVE OF HZ HERCULIS. Joss, P.C.; Avni, Y.; Bahcall, J.N. (Institute for Advanced Study, Princeton, New Jersey). Astrophys. J. 186: No. 2, 767-774 (1 Dec 1973).

The sharp minimum in the optical light curve of HZ Her is very different from the flat-bottomed X-ray eclipse of Her X-1. A simple model is presented which is consistent with the shapes of the minima of both the optical and X-ray light curves and which quantitatively reproduces the entire optical light curve (B-magnitudes). The essential feature of the model is the assumption that some of the incoming radiation from Her X-1 is absorbed well above the photosphere of HZ Her and is reradiated locally as optical light. Some possible observational consequences of this general class of models are discussed, including variations in the flux and spectrum of the X-rays at the beginning and end of the eclipse, optical emission lines, and UBV colors. (auth)

Solar Phenomena

Refer also to abstracts 6595, 6638, 6736, 7548, 7696, and 7885.

7735 (AD-764599) PROJECT THEMIS SUMMARY. Final Technical Report, 1 July 1969-30 June 1973. White, R. S. (California Univ., Riverside (USA). Inst. of Geophysics and Planetary Physics). Jul 1973. Contract N00014-69-A-0200-5001. 43p. (IGPP-UCR-73-32). NTIS $3.00.

Project Themis "The Variations in the Earth's Atmosphere Produced by Solar Radiations" at UCR has contributed significant additional knowledge to the properties of the Sun and the interaction of the Sun's radiation with the atmosphere, the chemistry of the atmosphere, climatology, and computer studies for remotely sensed imagery. The summaries of the scientific accomplishments are given for each of the experiments. The reports and publications directly related to the Themis research are given. The students and faculty that were supported by the Themis program are listed. (GRA)

7736 (N-72-13756) SUNSPOT ANALYSIS AND PREDICTION. Final Technical Report. Steyer, C. C. (Arkansas Univ., Little Rock (USA). Dept. of Mathematics and Engineering). 14 Oct 1971. Contract NAS8-21179. 85p. (NASA-CR-121059). NTIS.

An attempt is made to develop an accurate functional representation, using common trigonometric functions, of all existing sunspot data, both quantitative and qualitative, ancient and modern. It is concluded that the three periods of high sunspot activity (1935 to 1970, 1835 to 1870, and 1755 to 1790) are independent populations. It is also concluded that these populations have long periods of approximately 400, 500, and 610 years, respectively. The difficulties in assuming a periodicity of seven 11-year cycles of approximately 80 years are discussed. (STAR)

7737 (N-73-30923) PLANETARY ATMOSPHERIC PHYSICS AND SOLAR PHYSICS RESEARCH. Annual Report, 1972-1973. (Colorado Univ., Boulder (USA). Lab. for Atmospheric and Space Physics). Jun 1973. 58p. NTIS $5.00.

An overview is presented on current and planned research activities in the major areas of solar physics, planetary atmospheres, and space astronomy. The approach to these unsolved problems involves experimental techniques, theoretical analysis, and the use of computers to analyze the data from space experiments. The point is made that the research program is characterized by each activity interacting with the other activities in the laboratory. (auth)

7738 DECADE OF IMPROVEMENTS TO ORBITING SOLAR OBSERVATORIES. Follett, W. H.; Ostwald, L. T.; Simpson, J. O.; Spencer, T. M. (Ball Brothers Research Corp., Boulder, CO). J. Spacecraft Rockets; 11: No. 5, 327-334(May 1974).

Solar research in space preceded the satellite age by more than ten years. The NASA Orbiting Solar Observatory Program began in 1959 and was designed to extend a solar physics program which used balloon and sounding rockets as research platforms. The OSO satellites are an adaptation of the gyroscopically stabilized biaxial pointing system first used on the rockets in 1950. OSO-1, launched March 7, 1962, was the most stable orbiting solar research platform of its day with short-term pointed instrument jitter of only 0.5 arc-min. OSO-7 is today's most stable platform with residual spin axis coning of one arc-min and pointing jitter of only one arc-sec. The paper describes improvements which have greatly increased OSO capabilities and which have helped make dual-spin stabilization an attractive option for a wide variety of missions. (auth)

7739 VARIATIONS OF THE OCCURRENCE RATE OF DISCONTINUITIES IN THE INTERPLANETARY MAGNETIC FIELD. Mariani, F. (CNR, Frascati, Italy); Bavassano, B.; Villante, U.; Ness, N. F. J. Geophys. Res.; 78: No. 34, 8011-8022(1 Dec 1973).

A statistical study of magnetic field discontinuities for the interval February to October 1968 using data from the NASA Goddard Space Flight Center/University of Rome experiment on Pioneer 8 was conducted. High-resolution data (10-sec averages) were employed, stringent criteria being utilized to select more than 16,000 events, about 50% being identified as disturbances that are probably tangential discontinuities (TD). Near 1 AU the average occurrence rate of discontinuities is about 3.6/hr, whereas that of tangentiallike discontinuities is about 1.6/hr. The rate of occurrence of discontinuities is found to be correlated with the directional change of the field across the discontinuity surface. The normal to the TD discontinuity plane is most often perpendicular to the Archimedean spiral field configuration. A decrease of the rate of occurrence of TD is found with increasing heliocentric distance and/or with decreasing heliographic latitude. Possible interpretations of the effect are discussed. (auth)

7740 SCIENTIFIC OBJECTIVES OF SPACE EXPLORATION. Mark, H. (Ames Research Center, Moffett Field, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 34-37(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Short resumes are presented of the situation in the fields of interplanetary and interstellar space, lunar and planetary exploration, and stellar and galactic exploration. (WDM)

7741 TECHNOLOGY SPAWNING NEW DATA ON THE SUN. Gregory, W. H. Aviat. Week Space Technol.; 100: 34; 35; 37-42 (14 Jan 1974).

The big science attraction of the Sun is that it is the only star close enough to the Earth for high-resolution observation from the ground. What sounding rockets and spacecraft have done is to unlock a door to the life of the Sun otherwise invisible through or partly masked by the Earth's atmosphere. Visible light radiation from the Sun as well as longer-wave infrared and radio-frequency parts of the electromagnetic spectrum are readily observable from the ground where equipment weight and size are secondary. Postwar rocket and space technologies generated a new stage of solar physical understanding. Evolution of sounding rocket and spacecraft capability for solar observations has been predominantly a steady expansion of resolution in the high-frequency regime, which is related to higher temperatures, higher energies, and higher altitudes in the solar atmosphere. (IAA)

7742 CONNECTION OF DROUGHT ONSET IN THE EUROPEAN TERRITORY OF THE USSR WITH THE CORPUSCULAR RADIATION OF THE SUN. Pokrovskaya, T. V. Tr. Gl. Geofiz. Observ.; No. 299, 126-135(1973). (In Russian).

The annual variation of the geomagnetic index K_p in years with a different moisture character in the European territory of the USSR is examined in the spring-summer season. Years with rain deficiency are analyzed in detail. Some comparisons are made with the moisture regime in Kazakhstan. (tr-auth)

7743 SUPER LONG-RANGE PREDICTION OF SOLAR ACTIVITY. Sazonov, B. I. Tr. Gl. Geofiz. Observ.; No. 299, 142-146(1973). (In Russian).

The origin of the solar cycles of very long duration—178 and 1900 years—is examined. On the basis of the consideration of the common effect of these cycles on the level of sunspots principles are formulated which can be used as the basis for the super long-range prediction of solar activity. From a simplified scheme a prediction is made of the mean level of sunspots without consideration of the 11-year cyclicity for two centuries ahead. The prediction of solar activity can be the basis for the super long-range prediction of climate. (tr-auth)

7744 ENIGMA OF SOLAR NEUTRINOS. Omnes, R. (Paris Univ., Orsay, France). Recherche (Paris); 5: 15-21(Jan 1974). (In French).

The failure of observations to detect the flux of electron neutrinos from the Sun predicted by theory is shown to put in question the standard model of nuclear reactions in the Sun's interior. Following a review of the nature of the neutrino and its general im-

plications for astrophysics, the great difficulties of neutrino detection are discussed, along with the results of the neutrino search efforts of Davis and his colleagues since 1955. Some of the attempts to explore the conflict between observation and theory are examined, and the fascinating possibility of a new neutrino astronomy that could result from a solution of this conflict is pointed out. (IAA)

7745 PHOTOMETRY OF THE SOLAR CORONA OF MARCH 7, 1970. Bappu, M. K. V.; Bhattacharyya, J. C.; Sivaraman, K. R. (Inst. of Astrophysics, Kodaikanal, India). Pramana; 1: 117-128 (Sep 1973).

Isophotes obtained by equidensitometry techniques from four exposures of the March 7, 1970 corona were used for derivation of intensity distributions along the equator, poles, streamers, and dark "gaps" in the visible corona. The distributions differed from the van de Hulst curves for a maximum corona. The Kodaikanal measurements agree well with the NRL measurements of the outer corona made from a rocket coronagraph and together provide data from 1.2 to 8.0 solar radii along the solar equator. Radial intensity gradients for different position angles and the Ludendorff parameters obtained characterize this corona as typical of the solar maximum. (IAA) (auth)

7746 MAGNETISATION OF COMETS. Mendis, A.; Alfven, H. (Univ. of California, La Jolla, San Diego). Nature (London); 248: No. 5443, 36-37(1 Mar 1974).

It is stated that the presence of magnetic fields in the plasma tails of comets is suggested by the rayed structures and helical features observed. According to the present picture of solar wind–comet interaction, however, it is not clear how the interplanetary magnetic field could mix with the plasma in the comet tail since the solar wind and the associated interplanetary field are separated from the plasma by a contact surface. It has been suggested that the contact surface may be liable to various instabilities such that the interplanetary magnetic field may penetrate it and establish contact with the plasma in the tail, but the viability of such a process has not been demonstrated by detailed analysis. There are reasons to believe that the magnetic fields of celestial bodies may derive from the hydromagnetic conversion of kinetic energy into magnetic energy in their cores, although details of the conversion mechanism are not clear. One such mechanism is provided by the magnetohydrodynamic dynamo concept. An alternative and less speculative mechanism is what is termed the "poloidal field amplification" process, founded on observations in laboratory experiments and which has been used for a theory of the Earth's magnetic field. Whichever mechanism is preferred, however, the general requirements for a fluid body to become magnetized are that its volume and electrical conductivity are large enough, that there is sufficient internal kinetic energy for conversion to magnetic energy, and that there is a degree of ordering of the internal turbulent velocity field such as would be provided by rotation. Gas streaming out radially from a control nucleus cannot produce such magnetic field amplification, but if the nuclear region consists of a supplementary distributed source for the coma gases, as suggested by several authors, a turbulent flow with maximum velocities of the order of thermal velocity may be expected in this region, with the necessary ordering in the turbulent velocity field provided by rotation of the nuclear region. It is necessary, however, to determine if this magnetic field can be retained sufficiently long, and this is discussed. It seems that a comet, when sufficiently close to the Sun, may be able to generate an appreciable internal magnetic field and that the magnetic fields in the tail may then result from processes analogous to those producing the Earth's magnetotail. (UK)

7747 EQUILIBRIUM CONDENSATION IN A SOLAR NEBULA. Arrhenius, G.; De, R. R. (Univ. of California, La Jolla). Meteoritics; 8: 297-313(31 Dec 1973).

In attempts to reconstruct the environment of condensation of solar system materials, particularly exemplified by certain meteorite components, the relative temperatures of the gas and the solid are of critical importance. The relationships that determine the heat balance in a circumsolar grain–gas system are examined. Fundamental considerations show that regardless of opacity or gas density, the gas will always be at a higher temperature than the solid in such regions of the system where condensation is possible. Implications of the characteristic temperature differential between the gas and the condensing solid are discussed. (IAA) (auth)

7748 OBSERVATIONS OF INTERPLANETARY SCINTILLATIONS AT 327 MHz. Rao, A. P. (Tata Inst. of Fundamental Research, Ootacamund, India); Bhandari, S. M.; Ananthakrishnan, S. Aust. J. Phys.; 27: No. 1, 105-120(Feb 1974).

The properties of the interplanetary medium and the structures of 9 compact radio sources have been derived from the observed interplanetary scintillations at 327 MHz using the Ooty radio telescope. The observed scale size of the electron density irregularities has a value of 100 km in the elongation range 0.3 to 0.7 AU and shows no indication of increasing with elongation, as has been suggested by Hewish and Symonds (1969). The Bessel transforms of intensity fluctuations could seldom be used for estimating the solar wind velocity since the minima corresponding to the Fresnel filtering effect were rarely seen. The study of the skewness parameter of the probability distribution of intensity fluctuations at 327 MHz indicates that for elongations between 0.2 and 0.35 AU the thin screen model is satisfactory, but for larger elongations no clear conclusion can be drawn. (auth)

7749 MODE COUPLING IN THE SOLAR CORONA. I. Coupling Near The Plasma Level. Melrose, D. B. (CSIRO, Epping, Australia). Aust. J. Phys.; 27: No. 1, 31-42(Feb 1974).

The theory of mode coupling in the radiation from solar Type I storms is extended to treat coupling when the frequency f is near the plasma frequency f_p. It is found that Cohen's coupling ratio $Q = (f/f_t)^4$, where f_t is the transition frequency ($f \gg f_t$ for strong coupling), is to be multiplied by a factor $(1 - f_p^2/f^2)^{\frac{1}{2}}$ for QT regions, i.e., coupling is relatively suppressed close to the plasma level. The implications on the handedness of solar radio radiation are discussed. The possibility of depolarization due to mode coupling is considered briefly. (auth)

7750 MODE COUPLING IN THE SOLAR CORONA. II. Oblique Incidence. Melrose, D. B. (CSIRO, Epping, Australia). Aust. J. Phys.; 27: No. 1, 43-52(Feb 1974).

Previous discussions of mode coupling at a QT region have assumed vertical incidence and have thus invoked magnetic structures which violate div B = 0. A new method is developed here for calculating the coupling coefficients for oblique incidence so that coupling at a QT region can be treated without invoking nonphysical magnetic structures. The method involves solving the Booker quartic equation implicitly in terms of the familiar formulae of magnetoionic theory. A coupling approximation is introduced which involves one step in an iterative procedure to find explicit solutions from the implicit ones. The approximation is necessarily valid in a finite range about the critical coupling points. The present method is used to generalize the results of Cohen to allow oblique incidence. The results of the existing discussions of mode coupling for vertical incidence and nonphysical magnetic structures can be justified both qualitatively and semiquantitatively (although with a slightly different physical interpretation). (auth)

7751 RELEVANCE OF BIPOLAR TYPE I STORM STRUCTURES TO THE THEORY OF MODE COUPLING IN THE SOLAR CORONA. Melrose, D. B. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 4, 208-211(Oct 1973).

The polarization of Type I storms is discussed in terms of mode coupling in the QT region between the source and the Earth. It is suggested that refraction in the radial direction would allow radiation to propagate into a region of weaker field sooner than if refraction were ignored. Refraction alone does not appear to be adequate. Various additional effects are discussed. The most favorable is that the first QT region encountered is in a neutral plane. This would imply that a neutral plane, which must be favorably placed and must extend to relatively low heights ($\frac{1}{2}R_\odot$), must always be associated with a Type I storm center. (AU)

7752 SOLAR NEUTRINO PROBLEM. Prentice, A. J. R. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 4, 226-227(Oct 1973).

It is shown that the presence of a burnt-out core of only a few per cent of the solar mass lowers the neutrino flux drastically, by eliminating the contribution from the central region of the star, from where most of the flux arises without altering the luminosity. (AU)

7753 MOVING RADIO BURST ON THE LIMB OF THE SUN OBSERVED AT 80 AND 160 MHz. McLean, D. J. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 4, 222-226(Oct 1973).

The event comprised two phases: a Type I source which Moves around the limb, at different heights at the two frequencies, followed immediately by a source which is classified as Type IV because of its motion radially out from the limb, the two frequencies coming from almost the same height. (AU)

7754 UNUSUAL ABSORPTION OF A SOLAR TYPE II BURST BY SHADOW TYPE III BURSTS. Kai, K. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 4, 219-222(Oct 1973).

A Hα flare (12°N, 49°W) on 23 Aug 1968 was followed by a short-lived Type II burst which was recorded at 80 MHz. Observation of shadow inverted-U and Type III bursts against a background Type II emission suggests that absorption is caused by a fast electron beam ($v \sim c/3$) which would otherwise give

rise to "emissions" of the same type. Requirements for absorption are described. (AU)

7755 EVOLUTIONARY RELATION BETWEEN TYPE I STORM ACTIVITY AND THE S-COMPONENT AT CENTIMETRE WAVELENGTHS. Kai, K.; Sekiguchi, H. (Tokyo Univ.). Proc. Astron. Soc. Aust.; 2: No. 4, 217-219(Oct 1973).

S-components are believed to be thermal radiation from coronal condensations above a frequency which is typically 5 GHz and the spectrum indicates that the condensations are optically thin. The growth and decay of the magnetic field in the condensations will be reflected quite sensitively by the 3 cm flux densities. Strong magnetic fields in the corona are also necessary for the generation of Type I storms, as indicated by their close association with large sunsports, and by the observation of strong circular polarization and of bipolar structure. Intensification of the fields though necessary is not a sufficient condition for generation of Type I storm radiation. (AU)

7756 COMETS, SOLAR WIND, AND THE D/H RATIO. Reeves, H. (CEN de Saclay, Gif-sur-Yvette, France). Nature (London); 248: No. 5447, 398(29 Mar 1974).

The consequences of the following two astronomical observations are discussed. First, it is known that the Sun emits matter at the rate of $\sim 10^{12}$ g/sec in the form of the solar wind. The chemical composition of this seems to be similar to the solar photospheric composition, and it incorporates about 1% of atoms that are good candidates for grain formation, including CH_4, NH_3, and H_2O ices and silicate and iron dusts. A flux of $\sim 10^{10}$ g/sec of condensable material flows away to the remote parts of the solar system. Secondly, the number of newly arriving long period comets is about one a year, with a mean mass of $\sim 10^{23}$ g, these comets plausibly consisting of a conglomerate of ices and dusts. This means that a mean flux of $\sim 3 \times 10^{10}$ g/sec of cometary matter flows inwards from the remote part of the solar system. These fluxes agree to within one order of magnitude, and it is assumed that this is not pure coincidence, a model is discussed to correlate these facts with comet formation. It involves a stationary cloud to which matter is fed in through the solar wind and out by conglomerates of ices and dusts. Before this model becomes credible, however, several matters need to be clarified; for example, the observed distribution of kinetic energies, of ellipticities, and of orbital inclinations of the comets should find a reasonable explanation within the framework of the model. In connection with the origin of comets the importance of measuring the D/H ratio is stressed. Measurements of DCN/HCN, CH_3D/CH_4, and OD/OH ratios would appear important. (UK)

7757 EXPERIMENT TO MEASURE THE ANTIMATTER CONTENT OF THE TUNGUSKA METEOR. Crannell, H. (Catholic Univ. of America, Washington, DC). Nature (London); 248: No. 5447, 396-398(29 Mar 1974).

It is stated that several explantions have been offered for the features of the Tunguska meteor which fell in Siberia on 30 June 1908, including the suggestion that it was an antimatter meteor or even a black hole. The antimatter hypothesis is here examined, with a view to ascertaining what experimental tests could be carried out. In this connection the electromagnetic cascade shower is stated to be of special interest; this is produced in air by the decay into γ rays of the π^0s produced when antimatter nuclei annihilate, and when such a shower containing a wide spectrum of γ rays strikes the ground radioactive nuclei are produced as a result of many different photonuclear processes. Only a few of the reactions, however, produce nuclei sufficiently long-lived to be detected at present. Reactions producing the positron emitting ^{26}Al are given special consideration. In the proposed method the ^{26}Al content of rocks or soils is measured as a function of the distance from the center of the explosion; the highest concentration should be found near the center. In order to assess the technical feasibility of the method the production of ^{26}Al is examined in detail for the meteor conditions. The suitability of NaI (Tl) scintillation detectors is also discussed. (UK)

7758 CH_4 AND CH_2 IN COMETS. Black, J. K. (Harvard Univ., Cambridge, MA). Nature (London); 248: No. 5446, 319 (22 Mar 1974).

It is stated that if CH_4 exists in significant abundance in comets it could be a parent of observed CH and CH^+. It is difficult to observe CH_4 directly, but a rather specific although indirect means of detecting its presence is suggested. Dissociation of CH_4 by photons results in the formation of CH_2, and a search for the lines of CH_2 lying between wavelengths of 5000 and 9000 Å may be a useful and specific probe for both CH_2 and CH_4. (UK)

7759 THEORY OF TYPE I SOLAR RADIO BURSTS. Sy, W. N. C. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 4, 215-217(Oct 1973).

Preferential amplification of O-mode radiation in the source region is proposed as an explanation of the strong circular polarization of the bursts. The magneto-ionic modes are assumed to be negligibly coupled. (AU)

7760 POSITION OF A TYPE I STORM SOURCE IN THE MAGNETIC FIELD OF AN ACTIVE REGION. Dulk, G. A.; Nelson, G. J. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 4, 211-214(Oct 1973).

The radio polarization and the magnetic polarity of an active region were studied when a series of magnetograms and radioheliograms at 80 and 160 MHz were made during the passage of an unusually small, high polarized Type I source across the Sun's disk between August 31 and September 5, 1972. Centroids of the storm positions in relation to the dominant sunspot and magnetic neutral line are shown. Observations supported the hypothesis that ordinary mode radiation is responsible for such storms. (AU)

7761 LOCAL HYDROGEN GAS AND THE BACKGROUND LYMAN-ALPHA PATTERN. Wallis, M. K. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 103-119(Apr 1974).

The trapping of resonant solar photons in the local hydrogen cloud contributes substantially to the Lyman-α background. The contribution, commonly ignored as "multiply-scattered" photons, is described here as "cavity radiation" (the Sun being within a cavity as it moves through the gas). Two types of cavity are described and the backscattered radiation intensity calculated—a physical cavity produced by destructive processes, appropriate to hot gas; and a "Doppler cavity" due to gravitational acceleration of nearby hydrogen atoms and relevant to cool gas. The OG05 Lyman-α intensities are re-interpreted as the sum of near-isotropic cavity radiation plus the direct backscatter from asymmetrically distributed gas inside the cavity. The gas densities derived are in excess of 0.1 H-atoms cm^{-3} and quite possibly as high as the 0.2 to 0.3 cm^{-3} of independent local derivations. If the latter is the case, the Sun's speed through the gas is around 15 km s^{-1}. In all cases the cavity radiation is substantial at around 200 R. It explains the relatively steady, isotropic part of the background, and dispenses with the assumption of a large "galactic" contribution. Whether the gas is hot (6 to 10,000°K) or cool (40 to 80°K) is not easy to determine. Proton elastic collisions provide effective heating and would eliminate any secondary maximum due to gravitational focusing of cool gas. The variation with solar cycle, as revealed through changes in the radiation pressure, is perhaps the simplest way to distinguish between hot and cool gas. The Mariner 9 observation (2 yr after OG05) of a sharp reduction in the intensity minimum, appears to exclude the hot gas possibility. (auth)

7762 SPECTRAL DEPENDENCE OF SOLAR SOFT X-RAY FLUX VALUES OBTAINED BY SOLRAD 9. Dere, K. P.; Horan, D. M.; Kreplin, R. W. (Naval Research Lab., Washington, DC). J. Atmos. Terrest. Phys.; 36: No. 6, 989-994(Jun 1974).

The determination of solar energy flux values from ionization chamber experiments is discussed. Procedures and calculations necessary for the correction of Solrad 9 0.5 to 3 Å and 1 to 8 Å data and for the determination of the flare plasma temperature and emission measure are presented. These calculations are based on the continuum spectrum of Culhane (Mon. Not. R. Astron. Soc.; 144: 375 (1969)), the line spectrum of Tucker and Koren (Ap. J.; 168: 283 (1971)), and experimental values of the detector efficiencies. (auth)

7763 POLARIZATION OF THE RADIATION OF X-RAY FLARES ON THE SUN. Maldel'shtam, S. L. (Inst. of Spectroscopy, Moscow). Acta Phys. Acad. Sci. Hung.; 35: No. 1-4, 47-50(1974). (In Russian).

The interaction of oriented fluxes of accelerated electrons, producing polarized x-ray radiation, with the electrons and ions of the plasma is examined theoretically. (tr-auth)

7764 FLUORESCENCE OF MOLECULAR HYDROGEN EXCITED BY SOLAR EXTREME-ULTRAVIOLET RADIATION. Feldman, P.D.; Fastie, W.G. (Physics Department, Johns Hopkins University, Baltimore). Astrophys. J. Lett. 185: No. 2, L101-L104 (15 Oct 1973).

The ultraviolet fluorescence spectrum of H_2 excited by solar extreme-ultraviolet radiation was observed by the Apollo 17 Ultraviolet Spectrometer during a purge of the hydrogen fuel cells. Absorption of Lβ and Lyγ in the nearly resonant (6,0) and (11,0) Lyman bands completely accounts for the observed spectrum. (auth)

7765 VERTICAL PHASE VARIATION AND MECHANICAL FLUX IN THE SOLAR 5-MINUTE OSCILLATION. Canfield, R.C.; Musman, S. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratories, Sunspot, New Mexico). Astrophys. J. Lett. 184: No. 3, L131-L136 (15 Sept 1973).

We have made observations of the solar five-minute oscillation that allow measurement of the difference of phase between absorption lines formed over a range of almost 1000 km in the photosphere and

chromosphere. We derive phase velocities, group velocities, and mechanical fluxes. The amount of mechanical flux lost by the five-minute oscillation matches the estimated chromospheric radiative loss in quantity but has a different height distribution. This difference implies that a change in the mode of energy propagation may take place below 500 km. (auth)

7766 A SHORT-LIVED CHROMOSPHERIC FLARE-POINT WITH A LIFETIME OF 20 SECONDS AND RISE AND FALL TIMES OF 5 SECONDS. Hyder, C.L. (Laboratory for Solar Physics, NASA/GSFC New Mexico Station, Albuquerque); Epstein, G.L.; Hobbs, R.W. Astrophys. J. 185: No. 3, 985-989 (1 Nov 1973).

We have observed a chromospheric brightening in the Hα and Ca II K lines with a diameter of about 1 arc second. The time structure of this event, obtained with a relative resolution of 1 second, shows the rise time to be 4 seconds, the lifetime (FWHM) to be 20 seconds, and the decay time to be 5 seconds. This imposes new constraints on flare-point models. These restrictions can be accommodated easily by either an infall-impact flare model or a model invoking the precipitation of high-energy particles from the corona. (auth)

7767 THE STABILITY OF A VELOCITY SHEAR IN THE PRESENCE OF AN INHOMOGENEOUS MAGNETIC FIELD. Wilson, P. R. (Sydney Univ. (Australia). Dept. of Applied Mathematics). Astrophys. Space Sci.; 26: No. 2, 363-369 (Feb 1974).

The stability of a velocity shear in the presence of a parallel but non-uniform magnetic field is considered in general terms. Two special cases are then investigated; (i) the well known case of a plane interface at which a discontinuity in the magnetic field coincides with the velocity shear; (ii) an axially symmetric flow in which discontinuities in the magnetic and velocity fields occur at a cylindrical surface whose axis is parallel to the flow. In the first case the flow is stabilized if the rms Alfvén velocity of the magnetic field exceeds the shear velocity; a result consistent with that obtained by other writers. In the second case it is shown that the discontinuity in the magnetic field increases the stability of the system. The significance of this result for the stability of the flux ropes associated with sunspots in the solar convection zone is considered. (auth)

7768 OBSERVATION OF SUBMILLIMETER SOLAR RADIATION AT SEA LEVEL USING A FOURIER SPECTROMETER. Vardanyan, A.S.; Vystavkin, A.N.; Iskhakov, I.V.; Kolesov, Y.I.; Listvin, V.N.; Smirnov, A.Y.; Sokolov, A.V.; Sukhonin, E.V. (Institute of Radiotechnology and Electronics, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 3, 420-421 (Nov 1973).

Spectral measurements of solar radiation are made at sea level in the 4-12 cm^{-1} range with a spectral resolution of 0.5 cm^{-1} using a Fourier spectrometer. The efficiency of the methods of Fourier spectrometry for such measurements is shown. (auth)

7769 POSSIBLE MECHANISM FOR THE ACCELERATION OF ERUPTIVE PROMINENCES. Van Lyong, L. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 3, 350-355 (Nov 1973).

The motion of an eruptive prominence is interpreted as a consequence of the shock wave from a flare, which pulls upward the lines of force of the coronal magnetic field that had supported the prominence in its quiescent phase. A rough calculation indicates that this mechanism would explain the main features of the motion of eruptive prominences. Either an abrupt shedding of mass or the arrival of a secondary shock wave could account for the sudden accelerations that are observed; the accompanying emission flashes would result from compression of the gas. Shocks of ordinary strength within a prominence would not be observable, since they are isothermal and the magnetic field will tend to impede compression. (auth)

7770 TEMPERATURE DISTRIBUTION IN A PHOTOSPHERIC FACULA, DETERMINED BY SOLVING AN INTEGRAL EQUATION BY THE RANDOM GRADIENT SEARCH METHOD. Badalyan, O.G.; Prudkovskii, A.G. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 3, 356-359 (Nov 1973).

The difference equation relating the excess continuum radiation of faculae filaments to the difference in Planck functions at the same optical depth represents a Fredholm integral equation of the first kind, and has been solved by the random gradient search method. In this method one seeks by least squares a random perturbation of an initial function such that the corresponding norm decreases. The same perturbation is used several times, after which the random-search program is repeated. The process continues until the observed γ (cos θ) relation is approximated to specified accuracy (γ is the contrast of the facula). The maximum temperature difference between faculae and the undisturbed photosphere is thereby found to be +400°K (with τ=0.6 at 5000 Å); the minimum difference is -240°K (with τ=2.5-3.0). In the surface layers ($\tau \simeq 0.01$) the facular and photospheric temperatures differ by less than 50°K. The presence of a "cool" zone in faculae does not result from any requirement that faculae be completely invisible at the center of the disk. An application of the random gradient search method with minimal constraints on the class of unknown functions does entail certain difficulties if one attempts to represent the observed facular contrasts by using homogeneous photospheric models. (auth)

7771 LATITUDINAL ZONALITY ON THE SUN. Kozhevnikov, N.I. (P. K. Shternberg State Astronomical Institute). Sov. Astron.-AJ 17: No. 3, 360-362 (Nov 1973).

The distribution in heliographic latitude of the number of flare maxima and the observation periods of sunspot groups is examined in the article. The distribution curves exhibit a clear periodicity with a latitudinal period of 4.0°. (auth)

7772 COHERENT PROPAGATION OF CHARGED-PARTICLE BUNCHES IN RANDOM MAGNETIC FIELDS. Earl, J.A. (Department of Physics and Astronomy, University of Maryland, College Park). Astrophys. J. 188: No. 2, 379-377 (1 Mar 1974).

When the distribution function for energetic particles moving in interplanetary space is expressed in terms of eigenfunctions of an operator which describes pitch-angle scattering by random magnetic fields, the familiar phenomenon of diffusion is the dominant solution of the transport equations provided that the spectrum of magnetic fluctuations is not too steep. However, if the power-versus-wavenumber spectrum of the random fields has a spectral index $q>2$, the dominant solution of the same equations is a qualitatively different mode of transport in which density inhomogeneities propagate coherently along the guiding field with a characteristic velocity equal to half the particle speed. Physically, this effect occurs because the rate of pitch-angle scattering through 90° is so small that particles with velocity vectors in the forward hemisphere have a very small probability of being scattered into the backward hemisphere and vice versa. Thus, particles with velocities isotropically distributed within one hemisphere can move together as a coherent group. This paper, which extends classical transport theory to give a detailed treatment of the new mode, presents explicit formulae which describe the spatial and temporal structure of the coherent disturbance. It is shown that this disturbance evolves asymptotically into a moving Gaussian pulse whose width increases with time. The relationship between coherent and diffusive modes is examined with particular emphasis upon the situation in which both modes are simultaneously present. In applying these ideas to the propagation of solar cosmic rays, it is found that the prompt arrival and marked anisotropies seen in the early phases of solar proton events can be understood as a consequence of coherent propagation. However, the most striking implication of the theory is that the observed "scatter-free" propagation of solar-flare electrons below 1 MeV is a manifestation of the coherent mode in which an impulsive burst of electrons travels from the Sun to Earth with negligible dispersion. (auth)

7773 SOLAR MODELS WITH LOW NEUTRINO FLUXES. Ulrich, R.K. (Astronomy Department, University of California, Los Angeles). Astrophys. J. 188: No. 2, 369-378 (1 Mar 1974).

Models of the Sun which currently produce all their energy from nuclear reactions are examined in very general terms. It is concluded that a counting rate of 0.5 SNU is a firm lower bound for such models. It is also shown that a recent but concluded episode of pulsation in the Sun could not have caused mixing through modification of the nuclear reaction rates. Limitations on the rapidly rotating core model of Demarque, Mengel, and Sweigart and the central magnetic field model of Chitre, Ezer, and Stothers are discussed. Modification of all the nuclear-reaction-rate cross-section factors by 2 standard deviations in such a way as to reduce the neutrino fluxes yields a model with a counting rate of 1.7 SNU. (auth)

7774 ON SPATIAL VARIATIONS IN THE INTENSITY OF CHROMOSPHERIC Hα. Gebbie, K.B.; Steinitz, R. (Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder). Astrophys. J. 188: No. 2, 399-406 (1 Mar 1974).

We investigate the formation of patterns in Hα spectroheliograms and filtergrams. Introducing a source-sink-control diagram, we conclude that the Hα line source function in the quiet solar chromosphere is indirectly controlled by the photospheric radiation fields in the Balmer and Paschen continua. We demonstrate that in producing the observed patterns, horizontal spatial variations in the shape of the absorption profile are extremely effective compared to changes in the source and sink terms. Applying this mechanism, we compute asymptotic values for the contrasts and visibilities in chromospheric Hα. (auth)

7775 RELATIVE CORONAL ABUNDANCES DERIVED FROM X-RAY OBSERVATIONS. I. SODIUM, MAGNESIUM, ALUMINUM, SILICON, SULFUR, AND ARGON. Walker, A.B.C. Jr.; Rugge, H.R.; Weiss, K. (Space Physics Laboratory, The Aerospace Corporation, El Segundo, California). Astrophys. J. 188: No. 2, 423-440 (1 Mar 1974).

We have observed the coronal spectrum between 3.5 and 8.5 Å for several levels of coronal activity, and determined absolute fluxes for 79 lines and for the continuum. Identifications have been determined for the majority of the lines observed, and, in particular, for the resonance lines of Mg XI, Mg XII, Al XII, Al XIII, Si XIII, Si XIV, S XV, and S XVI. The measured fluxes of these lines have been used to construct a model

of the temperature dependence of the coronal emission measure between 1.5 and 10×10^{6}°K. This model is used to determine the relative abundances of Mg, Al, Si, and S. The relative abundances of Ar and Na were also computed, using the observed intensities of weak lines of these two elements. The relative abundances found are (A_{Si} has been arbitrarily set equal to 35×10^{-6}) $A_{Mg}=30\times10^{-6}$, $A_{Al}=2.5\times10^{-6}$, $A_{Si}=35\times10^{-6}$, $A_S=9\times10^{-6}$, $A_{Ar}=6\times10^{-6}$, and $A_{Na}=1.7\times10^{-6}$. These abundances are in good agreement with the results of previous analyses of the coronal XUV spectrum, and with photospheric abundances. We have used the coronal model based on the lines fluxes to calculate the expected continuum fluxes, and compared these calculated fluxes with the observed continuum fluxes. The agreement between calculated and observed continuum flux is good near ~8 Å, however, the calculated spectrum falls off more rapidly than the observed spectrum below ~6 Å. (auth)

7776 DIRECT OBSERVATION OF TEMPERATURE AMPLITUDE OF SOLAR 300-SECOND OSCILLATIONS. Hudson, H.S.; Lindsey, C.A. (Department of Physics, University of California, San Diego, California 92037). Astrophys. J. Lett. 187: No. 1, L35-L36 (1 Jan 1974).

The 300-second oscillations form the dominant source of variability of the solar infrared continuum. We have observed them at 20 μ with an amplitude $\Delta T_{rms}=3.0$°K over an area with an effective diameter of 33'. This new mode of observation of the 300-s oscillations should make possible a fundamental improvement in our knowledge of their nature and origin. (auth)

7777 THE SPATIAL DISTRIBUTION OF LYMAN α ON THE SUN. Prinz, D.K. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D. C.). Astrophys. J. 187: No. 2, 369-375 (15 Jan 1974).

One of the high spatial resolution, Lα line spectroheliograms obtained by the Naval Research Laboratory during a rocket flight on 1972 July 10 has been analyzed to show the distribution of Lα on the solar disk. The intensity distribution across selected cells, filaments, bright "points," and active regions is presented. The distribution of intensity with respect to area on the projected disk is shown to have a peak at $\sim3.8\times10^{15}$ photons cm^{-2} s^{-1} $sterad^{-1}$. Setting an upper limit to the intensity from cells, the north–south distribution of the integrated flux from cells is shown to be within 20 percent of that expected from a sphere having a uniform intensity except in the regions where active areas are prominent. The total flux at the Earth, 3.25×10^{11} photons cm^{-2} s^{-1}, agrees well with the Lα flux measured the previous day by the French OSO-5 experiment. It is reasoned that the variability of the total Lα flux may be due not only to the variations in the plage areas, but also to variations in the average cell intensity. (auth)

7778 A THEORETICAL AND EXPERIMENTAL STUDY OF Fe XIX TO Fe XXIV SOLAR-FLARE SPECTRA AND ISOELECTRONIC SPECTRA IN SULFUR. Fawcett, B.C. (Science Research Council, Astrophysics Research Divison of the RSRS, Culham Laboratory, Abingdon, Berkshire, England); Cowan, R.D.; Hayes, R.W. Astrophys. J. 187: No. 2, 377-383 (15 Jan 1974).

Atomic self-consistent field calculations are used to predict wavelengths and oscillator strengths of the $2p^n$–$2p^{n-1}3d$ transitions in Fe XIX to Fe XXIV. The validity of these calculations is checked through comparison with new experimental data in the isoelectronic sequences. In particular, sulfur classifications are correlated and new S IX identifications reported. The application of the results in Fe XIX to XXIV, combined with some observational and theoretical considerations affecting expected solar line intensities, leads to a more definitive analysis of solar-flare spectra of these ions. Data of value to the analysis of improved solar-flare spectrograms are also presented. (auth)

7779 THEORETICAL ANALYSIS OF THE Al I ABSORPTION SPECTRUM. Lin, C.D. (University of Chicago). Astrophys. J. 187: No. 2, 385-387 (15 Jan 1974).

A plot of oscillator strengths of the Al I $3s^23p^2P\rightarrow3s^2nd^2D$ transitions and the adjoining continuum, by the quantum-defect method, shows a good fit of the recent Kohl and Parkinson continuum data with earlier discrete measurements. The plot has the shape of a broad Beutler–Fano profile, with $\Gamma\simeq1.4$eV and $q\simeq0.8$; it thus indicates that most of the oscillator strength is contributed by the $3s^23p^2P\rightarrow3s3p^2\ ^2D$ transition represented by the broad peak. (auth)

7780 LIMITS TO SOLAR LIMB DARKENING AT A WAVELENGTH OF 1.4 MILLIMETERS DERIVED FROM ANTENNA-BEAM PARAMETERS. Ade, P.A.R.; Rather, J.D.G.; Clegg, P.E. (Department of Physics, Queen Mary College, London). Rather, J.D.G. Astrophys. J. 187: No. 2, 389-392 (15 Jan 1974).

Careful studies have been made to derive the performance characteristics of the NRAO 11-m dish in the 0.8–1.6 mm wavelength range. It is shown that incomplete reduction of data previously obtained with the same instrument has led certain authors to the erroneous conclusion that limb darkening exists at short millimeter wavelengths. Within the available resolution of the dish (with the error pattern deconvolved) the quiet-Sun brightness distribution is rectangular, with some indication of polar darkening. (auth)

7781 AN EXPLANATION OF THE SOLAR LIMB SHIFT. Hart, M.H. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 187: No. 2, 393-401 (15 Jan 1974).

Absorption lines in the solar spectrum are shifted as a result of collisions of the absorbing atoms with neutral hydrogen atoms. The shift, which would be to the red if only van der Waals forces between atoms were considered, is generally to the blue when the more realistic Lennard–Jones potential is used. The shift is proportional to the density of perturbing atoms, and is therefore smaller at the limb than it is at the center of the disk, where we see to greater depths in the atmosphere. This differential shift is suggested as the explanation of the solar limb effect. Computations using the Lennard–Jones potential and standard photospheric models correctly predict the magnitude and direction of the limb shift, as well as the functional forms of the observed variations of line shift and damping constant with distance from the center of the disk. (auth)

7782 LASER-PLASMA SPECTRA OF HIGHLY IONIZED FLUORINE. Feldman, U.; Doschek, G.A. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C.); Nagel, D.J.; Behring, W.E.; Cowan, R.D. Astrophys. J. 187: No. 2, 417-420 (15 Jan 1974).

Lines between 11.3 Å and 17.2 Å of lithium-like, helium-like, and hydrogen-like fluorine have been observed in spectra of laser-produced plasmas. These lines include nine members of the Lyman series of F IX; eight members of the principal series of F VIII; and satellite lines arising from doubly excited configurations of F VII and F VIII. Similar satellite lines of the abundant solar elements have been identified in soft X-ray spectra of solar flares. A wavelength list of fluorine lines is given, and physical conditions in the plasma are discussed. (auth)

7783 DETERMINATION OF THE SOLAR LYMAN-ALPHA FLUX INDEPENDENT OF CALIBRATION BY ULTRAVIOLET OBSERVATIONS OF COMET BENNETT. Keller, H.U. (Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder); Thomas, G.E. Astrophys. J. Lett. 186: No. 2, L87-L90 (1 Dec 1973).

The solar Lyman-alpha flux (an average of the blue inner wing) is determined from previously unreported OGO0-5 ultraviolet observations of Comet Bennett (1970 II). The curvature of the extended atomic-hydrogen tail yields the solar flux from calculations similar to those used in the analysis of dust tails. Only the positions, but not the absolute values, of the intensity maxima are used; and hence this method is independent of any instrumental calibration. (auth)

7784 POLAR MAGNETIC FIELDS AND THE NEW SOLAR CYCLE. Gillespie, B.; Harvey, J.; Livingston, W. (Kitt Peak National Observatory,* Tucson); Harvey, K. Astrophys. J. Lett. 186: No. 2, L85-L86 (1 Dec 1973).

Recent magnetograph observations show evidence of the onset of the new solar cycle (number 21). A small active region with the new-cycle polarity configuration appeared at S45° on 1973 August 22 and persisted until 1973 August 26. In addition, ephemeral active regions have shown a predominance of new-cycle polarity configurations at high latitudes, especially in the southern hemisphere. The polar magnetic fields reversed polarity during 1971–1972. This reversal is a prelude to the start of the new cycle according to the models of Babcock and Leighton. (auth)

7785 INTERPRETATION OF COLUMNAR CONTENT MEASUREMENTS OF THE SOLAR-WIND TURBULENCE. Callahan, P.S. (Jet Propulsion Laboratory, California Institute of Technology; and Downs Laboratory of Physics, California Institute of Technology). Astrophys. J. 187: No. 1, 185-190 (1 Jan 1974).

The temporal spectrum of measurements of the integrated electron columnar content between the Earth and a distant source are considered. The relation between this spectrum and the three-dimensional wavenumber spectrum of the solar-wind density is derived under the assumption that the correlation scale is the smallest scale of interest. The specific case of round-trip measurements to a spacecraft is investigated for a power-law solar-wind density spectrum. The resulting spectrum has a power-law envelope one power less steep than the solar-wind density spectrum with several deep minima superposed. (auth)

7786 SOLAR COSMIC-RAY ACCELERATION BY A PLASMA INSTABILITY. Gary, S.P. (Physics Department, College of William and Mary, Williamsburg, Virginia). Astrophys. J. 187: No. 1, 195-196 (1 Jan 1974).

Charged particles which are trapped in the potential troughs of an electrostatic plasma wave can be accelerated if the phase velocity of the wave increases with position. Energetic protons form solar flares may be accelerated in this way by the beam–plasma instability. (auth)

7787 CONVECTION AND MAGNETIC FIELDS IN AN ATMOSPHERE WITH CONSTANT TEMPERATURE GRADIENT. I. HYDRODYNAMIC FLOWS. Parker, E.N. (Department of Physics, Department of Astronomy and Astrophysics, University of Chicago). Astrophys. J. 186: No. 2, 643-664 (1 Dec 1973).

In order to deduce the fluid and field conditions deep in the

supergranules from the fluid motions and magnetic fields observed in the solar photosphere, it is necessary to have some idea of the depth to which the supergranules extend and the form of their internal fluid velocities. Toward this end a number of analytic solutions of the Navier–Stokes equations are given for circumstances possessing various facets of the supergranule environment in the Sun. These solutions, together with the earlier work by others, shows that the granules extend to depths in excess of their mean diameters, that the convective velocities probably do not diminish much, if any, with depth, and that across the tops of the supergranules at the photosphere the horizontal velocity is more or less independent of depth. (auth)

7788 CONVECTION AND MAGNETIC FIELDS IN AN ATMOSPHERE WITH CONSTANT TEMPERATURE GRADIENT. II. THE SUPERGRANULES AND MAGNETIC FIELDS. Parker, E.N. (Department of Physics, Department of Astronomy and Astrophysics, University of Chicago). Astrophys. J. 186: No. 2, 665-670 (1 Dec 1973).

The hydrodynamic properties of convective motions in a stratified atmosphere suggest that the supergranules in the solar photosphere extend to depths in excess of their horizontal diameters. The calculations presented here show that the weak fields which appear at the photosphere are as strong as, or stronger than, the horizontal fields anywhere in the supergranules below the surface. Hence the general $10–10^2$ gauss azimuthal field of the Sun, whose presence is indicated by the emerging bipolar magnetic regions, must lie below the base of the of the supergranules i.e., below a depth probably of the order of $2–5\times10^4$ km. Presumably then the azimuthal field is generated by nonuniform rotation below the supergranule convection and does not appear in the supergranule layer because of the high rate of turbulent diffusion loss from that layer. (auth)

7789 ON THE OBSERVATION OF THE F CORONA IN THE VICINITY OF THE SOLAR LIMB. Koutchmy, S. (Institut d'Astrophysique, Paris); Magnant, F. Astrophys. J. 186: No. 2, 671-678 (1 Dec 1973).

Theoretical calculations led Calbert and Beard to predict a much lower intensity of the F corona near the solar limb than the one generally accepted. We show that this does not agree with recent observations, especially airborne ones obtained far above the lower atmosphere. The measurements made on the ground during the eclipse of 1970 March 7 confirm the classical models. We suggest that new observations should be made in order to allow a choice between the apparently inconsistent interpretations of the measurements concerning the external F corona. (auth)

Galaxies

Refer also to abstracts 6109, 7573, 7598, and 7599.

7790 OPTICAL POSITIONS OF THE MARKARIAN GALAXIES. Peterson, S. D. (National Radio Astronomy Observatory, Green Bank, WV). Astron. J.; 78: No. 9, 811-827(Nov 1973).

Optical positions of the first 507 Markarian galaxies are given with an accuracy on the order of a few seconds of arc, and corrections to the original Markarian catalog are noted. (auth)

7791 ISOTOPIC ABUNDANCES AND THEIR VARIATIONS WITHIN THE GALAXY. Bertojo, M. (Ecole Normale Superieure de Jeunes Filles, Paris); Chui, M. F.; Townes, C. H. Science; 184: No. 4137, 619-623(10 May 1974).

The relative abundances of isotopic species in parts of the Galaxy outside the solar system represent an important record of the past, and one which is becoming increasingly available through measurement of molecular spectra in interstellar clouds and in stellar atmospheres. Information on isotopic abundances in interstellar material from microwave molecular spectra, along with a small amount of information from other spectral regions, is assembled and analyzed to obtain as clear a view of these abundances as is presently practical. (WDM)

7792 ABSORBING ICE MODEL OF INTERSTELLAR GRAINS. Swamy, K. S. K. (Rice Univ., Houston, TX); Jackson, W. M.; Donn, B. D. Astron. Nachr.; 293: No. 1-2, 43-48(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

Extinction curves have been calculated for Mie scattering by grains with a refractive index m equals to n – ik, where n was between 1.3 and 2.0 and k varied from 0 to 0.5. A good fit for the observed interstellar extinction in the wavelength region of 0.1 to 2.0 microns was obtained for particles with a radius of 0.1 micron and m equal to 1.3 to 0.2i. Inclusion of the changes in the refractive index in the vacuum ultraviolet region due to the strong absorptions of methane, ammonia, and water does not appreciably alter these results. Theoretical extinction curves for the composite medium of H_2O, NH_3, CH_4, and graphite show a general agreement with the observed interstellar reddening curve over the whole spectral range, in addition to producing kinks in the far-ultraviolet region. (auth) (IAA)

7793 DIFFUSE INTERSTELLAR BAND AT 4430 A AND THE SPECTRUM OF ATOMIC CALCIUM TRAPPED IN SOLID HYDROCARBONS. Duley, W. W.; Graham, W. R. M. Astron. Nachr.; 293: No. 1-2, 33-36(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

A tungsten lamp was used as a continuum source in a study of light dispersion by Ca atom impurities in solid hydrocarbons. The metal-doped hydrocarbon samples were prepared by controlled simultaneous deposition of a hydrocarbon molecule beam and a Ca atom beam on a quartz substrate at 500 to 77 deg K in a cryostat. A photomultiplier and a scanning spectrometer were used for spectrum recording. The experiments were designed to verify the hypothesis that the 4430-A diffuse interstellar band may be due to absorption by Ca atoms trapped in interstellar grains. The absorption bands observed in experiments with solid benzene, diphenyl, triphenylene, toluene, decane, tetradecane, methanol, and ethanol are discussed. (IAA)

7794 CONSIDERATIONS OF THE ORIGIN OF THE PLATT PARTICLES. Codina, S. Astron. Nachr.; 293: No. 1-2, 49-51 (1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

The possibility of the formation of polycyclic hydrocarbon molecules in the atmospheres of very cool stars and in the gases ejected by supernovae and Seyfert galaxies is analyzed. Donn (1968) had proposed that some polycyclic hydrocarbon molecules could be Platt particles. Gases with various densities are considered in an analysis of the processes occurring in the explosions of supernovae or nuclei of Seyfert galaxies. (IAA)

7795 INFRARED SPECTRA OF SILICATE GRAINS. Dorschner, J. (Univ., Jena, Ger.). Astron. Nachr.; 293: No. 1-2, 53-55(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

A table is presented showing the rock-forming terrestrial and meteoritic silicates which are assumed to play an important role in connection with the cosmic silicate dust. Internal vibrations of the SiO_4-tetrahedron are mainly responsible for the basic features of all silicates in the middle ir. The observed 10 micrometer emission is interpreted as due to Si–O stretching vibrations of circumstellar silicate grains. (IAA)

7796 EVIDENCE FOR THE CIRCUMSTELLAR FORMATION OF DUST. Schmidt, K. H. (Univ., Jena, Ger.). Astron. Nachr.; 293: No. 1-2, 57-63(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

In an examination of a catalog containing more than 4000 early-type stars it was found that O stars generally have a mean circumstellar extinction of 0.89 ± 0.55 mag. On the basis of this result the hypothesis is considered that all interstellar dust was formed in circumstellar regions during the process of star formation. The observed relative abundances of Ca and Na in the interstellar gas could be explained by assuming that dust formation occurs in dense clouds with radii of about 0.1 pc in the neighborhood of massive hot stars. (IAA)

7797 DUST PRODUCTION IN CIRCUMSTELLAR SPACE. Dorschner, J. (Univ., Jena, Ger.). Astron. Nachr.; 293: No. 1-2, 65-70(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

Observational indications which point out that the formation of dust particles in the circumstellar space usually accompanies the formation of most stars are discussed. An analytic treatment of circumstellar crushing processes leading to dust grains is presented. A necessary and sufficient condition for the escape of dust grains produced in circumstellar space by fragmentation is given, and dynamical effects on the grains are estimated. (auth) (IAA)

7798 DYNAMICAL SEPARATION OF DUST PARTICLES DURING CLOUD COLLISIONS. Zimmermann, H. (Univ., Jena, Ger.). Astron. Nachr.; 293: No. 1-2, 71-74(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

The dynamical behavior of dust particles during cloud collisions is calculated. It is shown that particles with a reciprocal specific cross section not smaller than .00005 g/sq cm at the end of a collision (and all subsequent processes) are gathered in a thin sheet in the inner parts of the new-built cloud. Particles with a smaller value of this quantity are distributed more or less uniformly among the gas of the cloud as before the collision. (auth) (IAA)

7799 GENETIC RELATION BETWEEN REFLECTION NEBULAE AND THEIR ILLUMINATING STARS. Schmidt, K. H. (Univ., Jena, Ger.). Astron. Nachr.; 293: No. 1-2, 75-77(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

From a discussion of catalogs of reflection nebulae based on the Palomar Observatory Sky Survey it is shown that a genetic relation exists between the nebulae and the illuminating stars. (auth) (IAA)

7800 ORIENTATION PARAMETER OF DUST GRAINS IN THREE SPECIAL CASES. Cugnon, P. (Observatoire Royal de Belgique, Brussels). Astron. Nachr.; 293: No. 1-2, 5-8(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

The orientation parameter F was obtained by solving a Fokker-Planck equation taking into account a two parameter model of collision and Jones and Spitzer's (1967) correction to Davis and Greenstein's (1951) interpretation of grain alignment by magnetic relaxation. Three cases were considered: (1) small values of the ratio delta of the collision relaxation time to the magnetic relaxation time, any elongation and magnetic anisotropy; (2) nearly spherical grains, with small magnetic anisotropy, any value of delta; and (3) oblate spheroids (or flat cylinders) with very high magnetic anisotropy, any value of delta. The results found in the first case showed that the parameter F is very sensitive to the model of collision, particularly for oblate spheroids. The effects of increasing field and grain temperature are discussed briefly on the basis of the results for nearly spherical grains. Unexpected negative values of the orientation parameter for small and moderate delta values obtained in the third case exclude the possibility of alignment by diamagnetic relaxation in graphite. (auth) (IAA)

7801 INTERSTELLAR DUST. Lequeux, J. Recherche (Paris); 5: 65-69(Jan 1974). (In French).

The recently recognized importance of interstellar dust in astrophysics is discussed. In dark and dense interstellar clouds, dust is shown to perform such functions, among others, as those of: (1) catalyst in interstellar molecule formation, and (2) protective shield for interstellar molecules against the destructive effects of stellar uv radiation which the dust particles absorb. The functions of dust particles in gaseous nebulae are also reviewed. The possible role of giant stars and of red supergiants in the origin of interstellar dust and the contributions of ir astronomy to its study are examined. (IAA)

7802 NEW INFRARED SOURCE IN M17. Kleinmann, D. E.; Wright, E. L. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. J.; 185: No. 3, L131-L133(1 Nov 1973).

A small (<10″), bright (20 f.u. at 10μ) source was discovered in the dusty, southwest part of M17. Its 10 to 20 μ color temperature was 200° ± 15° K and its 10-μ surface brightness was at least 10^{-9} W cm^{-2} μ^{-1} $sterad^{-1}$; these values were comparable to those found at the peaks of the two extended 10-μ sources previously discovered in M17. (auth)

7803 SPIRAL STRUCTURE VIEWED AS A DENSITY WAVE. Kalnajs, A. J. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 4, 174-177(Oct 1973).

Lindblat's discovery that force fields of flat galaxies by and large have a built-in bias which tends to preserve bisymmetrical structure from dissolution, and orbits in an axisymmetric galaxy are shown to have a key role in tightly wrapped patterns. A suggestion that the presence of gas in the outer parts can excite and amplify an elliptical or bar-like deformation of the massive central part of the galaxy is considered. (AU)

7804 EVOLUTION OF DENSE GALACTIC NUCLEI THROUGH DWARF STAR COLLISIONS. Shara, M. M.; Shaviv, G. (Tel Aviv Univ., Israel). Nature (London); 248: No. 5447, 398-400 (29 Mar 1974).

It is stated that detailed models of stellar collisions have so far been limited to collisions between two main sequence stars. It is here pointed out that a very important type of collision in dense galactic nuclei is that in which a white dwarf is involved, and such collisions are discussed. The evolution of a dense galactic nucleus depends on the transformations between the various stellar species due to stellar collisions, and a highly simplified model is presented for a spherical galactic nucleus. It is found that stellar collisions in dense galactic nuclei can explain the basic energetics of QSOs, N-type galaxies, Seyfert galaxy nuclei, and the central regions of bright elliptical galaxies, as well as their evolutionary relations and sequence. (UK)

7805 DENSITY WAVE MODEL OF THE GALAXY. Basu, B.; Bandyopadhaya, R.; Paul, S. N.; Roy, A. K.; Saha, G. (Jadavpur Univ., Calcutta). Indian J. Phys.; 47: No. 10, 614-626(Oct 1973).

The general gas dynamical equations were solved in the wave form and the general dispersion relation was deduced. This dispersion relation was used with simplifying assumptions plausible for special regions of the Galaxy, and results obtained were shown to be able to interpret some observed dynamical behaviors as well as the distributional property of the gas in those special regions. The analysis yielded the interpretation of (a) the absence of any wave-pattern in the central region of the Galaxy, (b) the large-scale deviation of the gas from the galactic plane in the outer regions of the Galaxy, and (c) the large-scale outflow of gas in the central region, as well as the large outward motion of the 3kpc arm. The analysis further indicates that in the solar neighborhood the rotation curve of the Galaxy may possess a local maximum. (auth)

7806 OPTICAL VARIABILITY OF THREE SEYFERT GALAXIES. Netzer, H. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 1P-5P(Apr 1974).

A photographic investigation of the three Seyfert galaxies NGC 4051, NGC 3227, and MARK 79 has been carried out. A new reduction process is described, which makes it possible to detect variations of 0.07 m. The galaxies NGC 4051 and Markarian 79 are found to be variable on a time scale of one month, with an amplitude larger than 0.2 m. (auth)

7807 GALACTIC SPIRAL ARMS AND EVOLUTION. Piddington, J. H. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 4, 170-173(Oct 1973).

The pattern of star creation in the galactic spiral arms can be explained either in terms of the density-wave theory or the hydromagnetic theory. The most notable differences in the predictions of the density-wave and magnetic theories are the gas density distribution and velocity field. The magnetic theory does not predict thin concentrations of gas, the distribution may be uniform or random, and this seems to agree more closely with observations. The velocity difference should be easily tested because the density-wave theory predicts V_r and V_ρ components while the magnetic theory predicts a (smaller) V_z component and also gradients $\partial V/\partial z$ of order 10 km s^{-1} kpc^{-1}. (AU)

7808 INCREMENTAL POLARIZATION OF STARLIGHT AT DIFFERENT LOCATIONS IN THE GALAXY. Fowler, L. A.; Harwit, M. (Cornell Univ., Ithaca, NY). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 227-236(Apr 1974).

Existing data, compiled by other investigators have been used to obtain the incremental polarization of starlight produced at different distances from the Sun and at different galactic latitudes and longitudes. The results are shown as a series of plots. It is found that, within spiral arms, the orientation of the incremental polarization vector is correlated with the direction of the arms. (auth)

7809 ALMOST COMPLETE SURVEY OF 21 CM LINE RADIATION FOR ABSOLUTE VALUE B GREATER THAN OR EQUAL TO 10°. II. The Accurate Data on Machine Readable Magnetic Tape. Heiles, C. (Univ. of California, Berkeley). Astron. Astrophys., Suppl. Ser.; 14: 557-564(Apr 1974).

The almost fully sampled Hat Creek λ21 cm line survey of the northern sky for $|b| \geq 10°$ was subjected to a correction procedure which minimizes internal errors. Comparison with previously existing determinations of zero level define the absolute survey baseline to within 0.1°K. These corrected data are available on a set of 3 magnetic tapes. (auth)

7810 ALMOST COMPLETE SURVEY OF 21 CM LINE RADIATION FOR ABSOLUTE VALUE B GREATER THAN OR EQUAL TO 10°. I. Atlas of Contour Maps. Heiles, C. (Univ. of California, Berkeley); Habing, H. J. Astron. Astrophys., Suppl. Ser.; 14: 1-555(Apr 1974).

The 85-foot telescope at Hat Creek, California, was used to survey the 21 cm line radiation outside of the strip bounded by $|b| \geq 10°$ and north of declination −30° over the velocity range from −92 to +75 kms^{-1}. The profiles, separated by 0.6° in galactic latitude and 0.3° in longitude, number approximately 140,000 and are presented in the form of contour maps of antenna temperature versus velocity and longitude, for constant latitude. (auth)

7811 DUST COOLING OF HOT GAS. Ostriker, J.P.; Silk, J. (Astronomy Department, University of California, Berkeley, California). Astrophys. J. Lett. 184: No. 3, L113-L115 (15 Sept 1973).

The cooling rate of a hot gas by ion-grain collisions is evaluated and shown to be significant at temperatures above 10^{6}° K. (auth)

7812 THERMAL-BREMSSTRAHLUNG INTERPRETATION OF CLUSTER X-RAY SOURCES. Lea, S.M.; Silk, J. (Department of Astronomy, University of California, Berkeley). Lea, S.M.; Silk, J; Kellogg, E.; Murray, S. Astrophys. J. Lett. 184: No. 3, L105-L111 (15 Sept 1973).

We have analyzed the X-ray data for the extended sources in Coma, Perseus, and Virgo in terms of an isothermal gas-sphere model, emitting

thermal-bremsstrahlung radiation. We find that the gas distribution is somewhat less centrally condensed than the galaxies, and that its mass is generally a small fraction of the binding mass of each cluster. In the case of the Coma cluster, approximately one-eighth of the binding mass (with an uncertainty of about 50 percent) may be in the form of hot gas at 10^8° K if $H_0=50$ km s^{-1} Mpc^{-1}. (auth)

7813 A SEARCH FOR RADIO EMISSION FROM S ANDROMEDAE. Spencer, J.H.; Burke, B.F. (Department of Physics, and Research Laboratory of Electronics, Massachusetts Institute of Technology). Astrophys. J. Lett. 185: No. 2, L83-L86 (15 Oct 1973).

Observations of the nucleus of M31 place upper limits on the present flux of S and that are inconsistent with conventional phenomenological models of supernova remnants. The observations support the recent evolutionary model of Gull. (auth)

7814 ABUNDANCES IN THE MAGELLANIC CLOUDS. Robertson, J.W. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University). Astrophys. J. 185: No. 3, 817-828 (1 Nov 1973).

New evolutionary sequences are presented at 3.5, 3.7, and 4.0 $M_{\odot}$, which allow a determination of the effects of abundance changes on the position of the Cepheid loops in the (log L, log T_e) -plane. If the existence of large numbers of Cepheids in the SMC with periods shorter than those in the LMC is interpreted as resulting from an abundance difference between the Clouds, then we require $\delta Y(SMC-LMC) \simeq -0.083$ or $\delta Z(SMC-LMC) \simeq -0.027$ or changes in both Y and Z, intermediate between these. Fitting the shortest-period Cepheids with sequences computed with Cox-Stewart opacities requires $Y_{LMC} \leq 0.23$ and $Z_{LMC} \geq 0.03$. Fitting the observations with sequences with envelope opacities greater (by a factor of 2 or so) than those of Cox and Stewart requires $Y_{LMC}=0.27\pm0.05$ (with $Z_{LMC}=0.025\pm0.01$) [the mean value of Y_{LMC} will be increased if rotation is important or the theoretical positions of the short-period cutoffs in the (log L, log T_e) -plane are used]. (auth)

7815 DETECTION OF 21-CENTIMETER HYDROGEN ABSORPTION IN THE HIGH-VELOCITY COMPONENT OF THE RADIO GALAXY PERSEUS A. De Young, D.S.; Roberts, M.S.; Saslaw, W.C. (National Radio Astronomy Observatory, Charlottesville, Virginia). Astrophys. J. 185: No. 3, 809-815 (1 Nov 1973).

Neutral-hydrogen absorption has been detected in the radio source Perseus A (NGC 1275). Several narrow absorption features are seen. They cluster about a recession velocity of 8120 km s^{-1}, which is 3000 km s^{-1} larger than the systemic velocity. It is shown that these hydrogen clouds lie in front of or within the 0".02 continuum source located in the nucleus of NGC 1275. Models implied by these observations are considered and include (1) superposition of two galaxies, (2) a "nuclear wind," and (3) radiatively driven mass loss through "line locking." (auth)

7816 NEIGHBORHOODS OF SPIRAL GALAXIES. I. MULTIPLE INTERACTING GALAXIES. Arp, H. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 185: No. 3, 797-808 (1 Nov 1973).

A multiple interacting system is defined as three or more galaxies falling within a few diameters of each other, at least two of which are strongly interacting. The more outstanding examples of multiple interacting galaxies are discussed. It is shown that these systems have a strong tendency to be aligned in chainlike configurations. It is also shown that they preferentially occur in the immediate vicinity of galaxies with much larger apparent diameters and much lower redshifts. The chance for these latter associations to be accidental is computed to be between 10^{-4} and 10^{-6}. (auth)

7817 WINDS AND X-RAYS FROM CLUSTERS OF GALAXIES. Yahil, A. (Institute for Advanced Study, Princeton, New Jersey); Ostriker, J.P. Astrophys. J. 185: No. 3, 787-795 (1 Nov 1973).

It is suggested that the X-ray emission observed in rich clusters of galaxies might be thermal bremsstrahlung of gas in a steady-state outflow from the clusters. The mass input of $\sim 10^3-10^4$ $M_{\odot}$ per year is consistent with that calculated in models of galactic evolution. The energy needed ($\sim 10^{45}-10^{46}$ ergs s^{-1}) could be due to nonthermal processes inside galaxies or to frictional heating of the intracluster gas. Measured as energy input per unit mass in stars, it is comparable to that produced by our Galaxy in nonthermal processes. The model is found to be in agreement with observation. If the ratio of grains to gas in the ejected matter is comparable to that observed in the interstellar medium of our Galaxy, then we would also predict a detectable diffuse infrared radiation from the center of clusters of galaxies, as well as reddening ~0.01 mag. (auth)

7818 THE SPHEROIDAL GRAVITATIONAL LENS. Bourassa, R.R.; Kantowski, R.; Norton, T.D. (The University of Oklahoma). Astrophys. J. 185: No. 3, 747-756 (1 Nov 1973).

The linearized Einstein gravitation theory is used to calculate the bending angle of a light ray as it passes exterior to a static spheroidal mass. The bending angle is then used to calculate general formulae for the intensification, distortion, and orientation of images seen around such masses. These expressions are then applied to simple models of an E7 and a Sc galaxy. (auth)

7819 OBSERVATIONS OF DIFFUSE GALACTIC Hα AND [N II] EMISSION. Reynolds, R.J.; Scherb, F. (NASA, Goddard Space Flight Center, Greenbelt, Maryland); Roesler, F.L. Astrophys. J. 185: No. 3, 869-876 (1 Nov 1973).

A study has been made of the intensities and radial velocities of faint galactic Hα and [N II] λ6584 emission lines not associated with any known bright H II regions. Although some (~10 percent) of the observed radiation may be scattered galactic light from bright H II regions in the galactic plane, most of the radiation appears to be produced by an ionized component of the interstellar gas which is distributed throughout the interstellar medium within the three nearby galactic spiral arms. In the local Orion arm the emitting gas has a temperature between 3000° and 8000°K and mean square electron density $\langle n_e^2 \rangle \simeq 0.05$ cm^{-6} in the galactic plane, while in the Perseus and Sagittarius arms $\langle n_e^2 \rangle \simeq 0.1$ and 0.9 cm^{-6}, respectively. (auth)

7820 IONIZATION EQUILIBRIA IN H I REGIONS. Weisheit, J.C. (Lawrence Livermore Laboratory, University of California). Astrophys. J. 185: No. 3, 877-885 (1 Nov 1973).

The ionization equilibria of carbon, nitrogen, and oxygen are computed for various steady-state models of the interstellar medium. Results are presented for conditions appropriate for interstellar clouds and for the intercloud gas. (auth)

7821 OBSERVATIONS OF OH MOLECULES IN INTERSTELLAR DUST CLOUDS. Crutcher, R.M. (Department of Astronomy, University of California, Los Angeles). Astrophys. J. 185: No. 3, 857-868 (1 Nov 1973).

Sixty-two Lynds dust clouds have been searched in the 1667-MHz line of OH; 74 percent were detected to an rms noise level of about 0.03°K. Those clouds already searched by Cudaback and Heiles were generally avoided. The survey concentrated on very opaque clouds, those assigned by Lynds to her opacity class 4, 5, or 6. The high detection rate strongly suggests that all very opaque dust clouds have significant OH densities. The OH velocity data are used to discuss the kinematics of the local dust-cloud population. A third of the 62 clouds were also searched for formaldehyde by Dieter. Most of these clouds have formaldehyde and OH lines at the same velocity. There is no correlation in the antenna temperatures of the two molecules. The molecular half-widths correlate strongly, but the formaldehyde half-widths are significantly smaller than those of the OH lines. In addition, several positions in the cold cloud seen in hydrogen self-absorption in the direction of the the galactic center were searched for OH. It is shown that this cloud must contain both cold atomic hydrogen and OH molecules. Finally, the only known dust cloud with a large excess hydrogen brightness temperature has been found to have OH emission at about the same velocity as the atomic hydrogen. (auth)

7822 A COLOR-MAGNITUDE DIAGRAM FOR THE RICH CLUSTER NGC 2164 IN THE LARGE MAGELLANIC CLOUD. Hodge, P.W.; Flower, P.J. (Astronomy Department, University of Washington, Seattle). Astrophys. J. 185: No. 3, 829-841 (1 Nov 1973).

Photoelectric and photographic photometry of stars in the populous young ("blue globular") cluster NGC 2164 provide a color-magnitude diagram. The main-sequence turnoff is found to lie at $M_v \sim -2$, and a total of ~40 stars occupy the giant region. The rich giant branch allows detailed comparisons with theoretical evolutionary tracks, which show that both in shape and in evolutionary rate, the observational results agree with the theoretical calculations for $M \sim 7M_{\odot}$. Stars are identified in the initial giant phase, in the helium-burning phase, and in the second giant-branch phase. (auth)

7823 A SEARCH FOR POSSIBLE STELLAR MEMBERS OF THE α-SPIRAL ARM. Dodd, R.J. (Royal Observatory, Edinburgh (UK)). Astrophys. Space Sci.; 26: No. 2, 513-519(Feb 1974).

The proper motions of groups of stars, selected according to magnitude and color, near (l,b) = (140°,0°), were analyzed in an attempt to identify possible members of the α-spiral arm defined by Verschuur from H I observations. Other than late type giants the only objects whose distance corresponded to that of this arm were a small group of reddened early type stars. (auth)

7824 CLUSTERS OF GALAXIES AS A POSSIBLE SOURCE OF BACKGROUND X RAYS. Prilutskii, O.F.; Rozental', I.L. Sov. Astron.-AJ 17: No. 3, 297-300 (Nov 1973).

Various models for the background radiation are discussed. Synchrotron and Compton-synchrotron models have been proposed but entail certain difficulties. A model is suggested wherein the emission of heated gas in galaxy clusters provides the main source of background x rays. The intensity and energy spectrum of the background radiation are calculated on this hypothesis. (auth)

7825 POTENTIAL ENERGY OF GRAVITATIONALLY INTERACTING SPHERICAL GALAXIES. Potdar, A.; Ballabh, G.M. (Osmania Univ., Hyderabad (India)). Astrophys. Space Sci.; 26: No. 2, 353-362(Feb 1974).

A theory has been developed for obtaining the potential energy

of two interpenetrating spherically symmetric galaxies of unequal dimensions due to their mutual gravitational interaction. The mass distribution in both the galaxies is assumed to be that of a polytrope of integral index. A basic function that occurs in the theory has been tabulated for the cases of polytropes of indices n = 0 and 4 for four ratios of the radii. (auth)

7826 ADIABATIC PULSATIONS AND CONVECTIVE INSTABILITY OF UNIFORMLY ROTATING GASEOUS MASSES. Kochhar, R. K.; Trehan, S. K. (Punjab Univ., Chandigarh (India)). Astrophys. Space Sci.; 26: No. 2, 271-287(Feb 1974).

Third-order virial equations are used to investigate the oscillations and the stability of the sequence of uniformly rotating compressible Maclaurin spheroids, referred to in an inertial frame. It is seen that in the case of the oscillations belonging to the third harmonics, the frequency spectrum of the Maclaurin sequence referred to in an inertial frame is distinct from the spectrum of the Maclaurin sequence considered stationary in a rotating frame of reference. Considering the Maclaurin sequence in an inertial frame, the neutral point and the point of onset of dynamical instability (corresponding to the third harmonic deformations) are isolated. They occur for the values of the eccentricity e = 0.73113 and 0.96696, respectively. The neutral point is the analogue of the first point of bifurcation along the Dedekind sequence of ellipsoids and is distinct from the neutral point (e = 0.89926) along the Maclaurin sequence considered stationary in a rotating frame; this latter point is the analogue of the first point of bifurcation along the Jacobian sequence. Both the Maclaurin sequences in an inertial frame and in a rotating frame become, however, dynamically unstable for the same eccentricity e = 0.96696. (auth)

7827 HIGH-ENERGY X-RAYS FROM THE PERSEUS CLUSTER. Bui-Van, A.; Hurley, K.; Vedrenne, G. (Center d'Étude Spatiale des Rayonnements, Toulouse, France). Astrophys. J. 188: No. 2, 217-219 (1 Mar 1974).

X-radiation has been observed from the Perseus cluster at energies between 53 and 93 keV. The spectrum is consistent with a power law, and a model for inverse Compton X-ray production is presented. (auth)

7828 INVERSE COMPTON RADIATION AND THE MAGNETIC FIELD IN CLUSTERS OF GALAXIES. Harris, D.E.; Romanishin, W. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts). Astrophys. J. 188: No. 2, 209-216 (1 Mar 1974).

Radio observations below 200 MHz are reported for the cluster Abell 401. These data together with Uhuru X-ray measurements and relevant data for other clusters of galaxies are interpreted in terms of an ensemble of relativistic electrons producing radio emission by the synchrotron process and X-rays by the inverse Compton process. Formulae are presented which relate the observations to the relativistic electron spectra: magnetic fields of 10^{-7} to 10^{-5} gauss and total energies of 10^{62} to 10^{63} ergs are required. We believe that the critical test of the inverse Compton model will come from X-ray observations between 10 and 100 keV and have calculated X-ray intensities predicted for these energies. (auth)

7829 OPTICAL THICKNESS IN THE He I SINGLET SPECTRUM OF NEBULAE. Robbins, R.R.; Bernat, A.P. (Department of Astronomy, The University of Texas at Austin). Astrophys. J. 188: No. 2, 309-314 (1 Mar 1974).

An integral equation expressing the transfer of resonance line radiation in the He I singlets has been solved for nebular models consisting of differentially expanding uniform spheres. Solutions have been obtained numerically for a variety of temperatures, optical depths, expansion velocities, and scattering functions appropriate to nebulae. Comparison of the transfer solutions to observed helium-singlet line intensities gives optical depths for various nebulae in the resonance lines in the ground-state bound-free continuum. There is considerable variation seen in the He^0 optical thicknesses: at the bound-free continuum limit λ504, the optical depth ranges from 0.064 to 0.72 in a group of 14 observed nebulae. The He^0 abundance does not appear sufficiently high in any of these objects to modify existing He/H ratios for nebulae derived on the basis of negligible neutral helium. Further discussion of the results demonstrates that transfer solutions of this type provide a sensitive observational test of computed ionization-stratification models for nebulae. (auth)

7830 ON THE STEADY FLOW OF GAS FROM THE NUCLEI OF SEYFERT GALAXIES. Wolfe, A.M. (Physics Department, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Astrophys. J. 188: No. 2, 243-254 (1 Mar 1974).

Heating of gas by energy released during explosive events produces hot ($T \sim 5\times10^{6}$°K) winds in Seyfert nuclei. Steady-state solutions indicate that supersonic velocities up to ~800 kms^{-1} are obtainable. Lyman continuum radiation emitted by the wind ionizes and maintains temperature of cooler ($T \sim 10^{4}$°K) gas clouds seen in emission, and dominates energy losses during early stages of expansion. A study of stability of the thermal equilibrium state leads to a two-component model: a hot stable phase (the wind), in pressure equilibrium with a cooler stable phase (clouds). Extreme variations in cloud electron densities are a consequence of the steep decrease with radius of external pressure. Cloud dynamics are related to the radius of formation and internal parameters. Permitted lines of H are emitted by high-density clouds formed at the base of the wind, while forbidden lines arise in radially moving clouds, produced throughout the wind. It is shown that one of the latter clouds seen in projection against the nonstellar continuum can explain observed, blueshifted absorption lines. Effects of the wind upon the central galactic region, such as the sweeping out of interstellar H^0, the radial motions of spiral arms, and the production of large-scale turbulent clouds, are also considered. (auth)

7831 THE DEFINITION, VISIBILITY, AND SIGNIFICANCE OF REDSHIFT-MAGNITUDE BANDS. Tifft, W.G. (Steward Observatory, University of Arizona, Tucson, Arizona 85721). Astrophys. J. 188: No. 2, 221-232 (1 Mar 1974).

Redshift-magnitude bands as they occur in the Coma cluster are formally defined, and the original bands observed in 1972 are shown to have a likelihood of random occurrence of only 0.005 independent of their direction. The properties of the Coma bands transformed to m_0 magnitudes and used to show that an independent sample of outlying Coma galaxies shows strong band-related characteristics. The properties of the Coma bands are then used to predict band properties for the A2199 cluster. The resultant power-spectrum test of a preliminary A2199 sample also shows a band-related morphological separation as in Coma. (auth)

7832 STUDIES OF NEUTRAL-HYDROGEN CLOUD STRUCTURE. Verschuur, G.L. (National Radio Astronomy Observatory, Charlottesville, Virginia). Astrophys. J. Suppl. Ser. 27: No. 238, 65-112 (Feb 1974).

The properties of 200 neutral hydrogen clouds are discussed and the data suggest that clouds are not moving as randomly as has heretofore been suggested. Clouds are often filamentary or parts of filaments. Some of these filaments have very striking velocity gradients along their length, sometimes as great as 10-15 km s^{-1} change over 5° of angle. Typical cloud masses are $10\,M_\odot$ for a 3 pc diameter cloud and the mass of the H I in the filaments is of this order per length of 3 pc in the filaments. The observations for two regions surveyed are given here in toto to show the nature of the small-scale structure in the interstellar H I. (auth)

7833 DETECTION OF INTERSTELLAR LITHIUM IN THE DIRECTION OF 55 CYGNI. Vanden Bout, P.A.; Grupsmith, G. (University of Texas at Austin). Astrophys. J. Lett. 187: No. 1, L9-L11 (1 Jan 1974).

The λ6708 line of Li I has been detected in the interstellar spectrum of 55 Cyg with a strength of 5.2 ± 0.8 mÅ equivalent width. Determination of the ionization equilibrium from observations of Ca I λ4226 Ca II H and K yields a column density $N(Li) = 3.4\times10^{12}$ cm^{-2}. Comparison with the Ca, Fe I, and H abundance in this direction indicates that the heavy elements are depleted with respect to their solar system abundance but not as strongly as in the direction of ξ Oph. No $^7Li/^6Li$ ratio could be determined. (auth)

7834 OBSERVATIONS OF THE INFRARED RADIATION FROM THE NUCLEI OF NGC 1068 AND NGC 4151. Stein, W.A. (University of California, San Diego, and University of Minnesota); Gillett, F.C.; Merill, K.M. Astrophys. J. 187: No. 2, 213-217 (15 Jan 1974).

Data resulting from monitoring the flux of radiation at $\lambda = 11$ μ from NGC 1068 and NGC 4151 are presented. There is some evidence for changes of flux of 50 percent on a time scale of approximately 100 days from NGC 4151. This evidence is suggestive but not compelling. Limits are set on the possible change of the 11-μ flux from NGC 1068. The energy distribution of radiation from NGC 1068 between 8 and 13 μ has been shown to have no spectral features within the accuracy and resolution of our measurement. This is in contrast to energy distributions observed from galactic sources in which the source of energy is generally interpreted as thermal reradiation from grains. (auth)

7835 SPECTROSCOPIC OBSERVATIONS OF NGC 4676. Stockton, A. (Institute for Astronomy, University of Hawaii). Astrophys. J. 187: No. 2, 219-221 (15 Jan 1974).

New spectroscopic observations of the peculiar double galaxy NGC 4676 are presented. These observations reverse the sense of the velocity difference between the two galaxies previously determined by Burbidge and Burbidge and thus remove a major objection to the tidal model for this system proposed by Toomre and Toomre. A-type stars dominate the light from all parts of the northern component, including the entire length of the long, narrow tail, as well as the light from at least one part of the southern component. The observations are consistent with a rapid, brief period of star formations during the tidal encounter. (auth)

7836 A DEVIATION-DEFECT METHOD FOR THE DETECTION OF OPTICALLY THICK NEUTRAL HYDROGEN. Baker, P.L. (National Radio Astronomy Observatory). Astrophys. J. 187: No. 2, 223-229 (15 Jan 1974).

Quantitative measurements of the spatial fluctuations of neutral hydrogen emission can be used to show the presence of optically thick gas. Optically thick gas layers do not appear to produce the spatial fluctuations of emission characteristic of optically thin gas; moreover, if emission from optically thin gas passes through optically thick gas, its spatial fluctuations are diminished. Based on this effect, a detection technique called the deviation–defect method has been developed and tested against interferometric measurements of absorption spectra. All optically thick gas features detected by the deviation–defect method are confirmed by the interferometer results. The new method has been applied to a large sample of the sky, and a very extensive optically thick hydrogen layer in the galactic anticenter has been mapped. Not all optically thick gas layers can be detected by this method. The layers must be many degrees in size to be observable in present hydrogen line data. Given this restriction, it is astrophysically significant that detections have been achieved. The results may indicate that some triggering mechanism initiates the formation of the cloud medium. (auth)

7837 THE SIZE OF NGC 1068 AT 10 MICRONS. Becklin, E.E.; Matthews, K.; Neugebauer, G.; Wynn–Williams, C.G. Astrophys. J. Lett. 186: No. 2, L69-L72 (1 Dec 1973).

Scans of the Seyfert galaxy NGC 1068 show that most of its 10–μ radiation arises from an area approximately 60 pc (1″) in diameter. This is interpreted as evidence that the infrared emission is not synchrotron radiation. (auth)

7838 THE DISTRIBUTION OF REDSHIFTS OF RADIO GALAXIES WITH DIFFERENT OPTICAL SPECTRA AND FORMS. Burbridge, G.R.; O'Dell, S.L. (Department of Physics, University of California, San Diego). Astrophys. J. Lett. 186: No. 2, L59-L62 (1 Dec 1973).

The distribution of redshifts of 222 radio galaxies has been subjected to a power–spectrum analysis. No statistically significant spectral peaks are present for galaxies showing normal absorption–line characteristics; on the other hand, significant spectral peaks are present for those exhibiting strong emission features. Of these spectral peaks, the most significant, at a wavelength of 0.031 in redshift, occurs for those strong–emission radio galaxies which are also compact. The result is consistent with the proposal suggested earlier by Burbidge that the nonrandom features, which may suggest intrinsic redshifts, are confined to those objects—QSOs, N systems, etc.—in which radiation from stars does not dominate. Possible explanations of the apparently nonrandom features are briefly discussed. Finally a table of the most recently published small-redshift QSOs, and compact emission-line galaxies is presented. The redshifts appear to conform to the 0.061 (or 0.031) periodicity found earlier. (auth)

7839 INTERSTELLAR ABSORPTION OF X-RAYS. Fireman, E.L. (Smithsonian Astrophysical Observatory, Cambridge, Massachusetts). Astrophys. J. 187: No. 1, 57-60 (1 Jan 1974).

The photoabsorption cross–sections of some medium–weight elements that has been ignored in calculations of interstellar X–ray absorption, as well as the effect of interstellar dust grains on X–ray absorption, are computed. If these ignored elements (mainly iron) are present in solar (cosmic) abundance, they increase the X–ray attenuation by 270 percent at 7.1 keV, by 21 percent at 1.5 keV, and by smaller percentages at lower energies. Dust grains, on the other hand, reduce the attenuation because atoms in the interior of the grain are blanketed, particularly for soft X–rays. Dust grains of thicknesses 8.4×10^{18} and 2.1×10^{18} atoms cm^{-2} (approximately 0.6 and 0.15 μ in radius) reduce the attenuations by 95 and 30 percent, respectively, for 0.6–keV X–rays. The amount of material in the line of sight, when derived from X–ray absorption, depends significantly on the sizes of dust grains for soft X–ray sources and on the iron abundance for hard X–ray sources. (auth)

7840 RADIO OBSERVATIONS OF TWO CLUSTERS OF GALAXIES. Donivan, F.F. Jr. (Department of Physical Sciences, University of Florida, Gainesville); Carr, T.D.; Omer, G.C. Jr. Astrophys. J. 187: No. 1, 11-18 (1 Jan 1974).

Maps including the Coma and Hercules clusters of galaxies were made at 195, 318, and 611 MHz, and were compared with optical counts of galaxies in the clusters. An extended region of radio emission approximately 20′ in diameter was observed at the center of the Coma cluster. A distributed source region was also observed which appears to include the Hercules cluster, although the possibility that is just an irregularity in the galactic foreground radiation cannot be completely ruled out. (auth)

7841 H I EMISSION FROM STEPHAN'S QUINTET. Shostak, G.S. (National Radio Astronomy Obvservatory, Charlottesville, Virginia). Astrophys. J. 187: No. 1, 19-24 (1 Jan 1974).

Neutral hydrogen emission profiles of two members of Stephan's Quintet, NGC 7320 and NGC 7319 (with redshifts of 744 and 6620 km s^{-1}, respectively) are presented. By requiring that the ratios M_{HI}/M_T and M_T/L_{pg} for these galaxies be normal for their classification, distances can be derived which are independent of the redshifts. These are 17(+17,–8) Mpc and NGC 7320 and 47(+55,–26) Mpc for NGC 7319. Although the uncertainties are large, the most probable distances derived in this fashion imply that these galaxies are unlikely to be physically related. The bulk of the uncertainty is not observational, but results from dispersions in the compiled integral properties of galaxies. Detection of a low–luminosity anonymous galaxy about 68′ west of the Quintet, having a redshift of 886 km s^{-1}, further strengthens the contention that NGC 7320 is a member of a group which includes the large spiral NGC 7331 and which is at a distance of 10–20 Mpc. (auth)

7842 CARBON RECOMBINATION LINES AND INTERSTELLAR HYDROGEN CLOUDS. Dupree, A.K. (Harvard College Observatory, Cambridge, Massachusetts). Astrophys. J. 187: No. 1, 25-39 (1 Jan 1974).

Observation of radiofrequency recombination lines of carbon are reviewed. For three sources, the observed frequency dependence of the line power ($T_L\Delta v_L$) is used in conjunction with theoretical calculations of level populations to derive parameters of the emitting regions. In two sources, NGC 2024 and W3A, these line intensities are consistent with formation in a dense H I cloud lying in front of the nearby H II region. Stimulated emission caused by a background continuum enhances the line intensities at low frequencies. The line may originate in outer layers of molecular clouds and/or at the boundaries of expanding H II regions. The carbon–emission regions in these sources are clouds with linear dimensions of ~0.4 pc, temperatures of ~50°–100°K, and electron densities of ~20 cm^{-3}. The observed hydrogen ionization suggests an atomic–hydrogen density of 2×10^4 atoms cm^{-3}, and requires a hydrogen ionization rate of $\sim2\times10^{-14}$ s^{-1} if atomic carbon is not depleted. Observations of the carbon line in Orion A do not agree with a single–cloud model. (auth)

7843 OBSERVATION OF GAMMA–RADIATION FROM THE GALACTIC CENTER REGION. Share, G.H.; Kinzer, R.L.; Seeman, N. (Laboratory for Cosmic Ray Physics, Naval Research Laboratory, Washington, D. C.). Astrophys. J. 187: No. 1, 45-56 (1 Jan 1974).

A balloon–borne investigation of the region in the vicinity of the galactic center was performed with a γ–ray telescope having an angular resolution of about 1 1/2° above 15 MeV. A narrow band of emission about 3° wide, lying along the galactic equator, was observed over the atmospheric background, and confirms the detection of galactic γ–radiation first observed above 100 MeV from OSO–3. The integral intensity above 15 MeV is about 3.5×10^{-4} γ cm^{-2} s^{-1} rad^{-1}, but is dependent on the assumed spectrum. A comparison with the measurements above 100 MeV indicates that at least 50 percent of the radiation comes from the decay of π^0 mesons produced in cosmic–ray collisions on interstellar gas. The possibility that point sources also contribute to this excess cannot be ruled out; however, we are unable to confirm the existence of any of the reported γ–ray sources within 20° of the galactic center. Our results suggest that either these suspected sources are variable or they have hard emission spectra (e.g., π^0 decay). (auth)

7844 COMMENT ON "GALACTIC MAGNETIC FIELDS: CELLULAR OR FILAMENTARY STRUCTURE?". Parker, E.N. (Department of Physics, Department of Astronomy and Astrophysics, University of Chicago). Astrophys. J. 187: No. 1, 191-192 (1 Jan 1974).

The recent statistical studies of Michel and Yahil emphasize again the difficulty in interpreting the observed Faraday rotation measures in terms of an unambiguous model of the galactic magnetic field. We have difficulty in understanding their specific suggestion that the magnetic fields expelled from stars have anything to do with the model. (auth)

7845 REPLY TO "COMMENT ON 'GALACTIC MAGNETIC FIELDS: CELLULAR OR FILAMENTARY STRUCTURE?'". Michel, F.C. (Space Physics and Astronomy Department, Rice University, Houston, Texas). Astrophys. J. 187: No. 1, 193-194 (1 Jan 1974).

We reiterate that the Sun is not expected to be a rotation–measure source. Other localized objects could be, and a specific example is described. (auth)

7846 THE DISTRIBUTION OF GALACTIC CARBON MONOXIDE: A PRELIMINARY SURVEY. Schwartz, P.R. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington D. C.); Wilson, W.J.; Epstein, E.E. Astrophys. J. 186: No. 2, 529-536 (1 Dec 1973).

A preliminary survey near the galactic plane between longitudes 10° and 70° reveals that CO has velocity and spatial distributions similar to those of neutral hydrogen. (auth)

Cosmology

Refer also to abstracts 8601, 8615, and 8616.

7847 DEUTERIUM IN THE UNIVERSE. Pasachoff, J. M.; Fowler, W. A. Sci. Amer.; 230: No. 5, 108-118(May 1974).

All the deuterium in the Universe may have been made in the first 15 minutes after the "big bang". Observations leading to estimates of its abundance which provide evidence on conditions at that time are reviewed. (WDM)

7848 OBLATENESS OF THE SUN AND RELATIVITY. Dicke, R. H. (Princeton Univ., NJ). Science; 184: No. 4135, 419-429 (26 Apr 1974).

The scalar-tensor theory of gravitation is reviewed in terms of historical development, physical problems, observational problem, oblateness data, and effects of atmospheric and solar disturbances. (WDM)

7849 UPPER LIMIT OF THE DENSITY OF EXTRATERRESTRIAL GRAVITATIONAL RADIATION. Braginskii, V. B.; Manukin, A. B.; Popov, E. I.; Rudenko, V. N.; Khorev, A. A. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 66: No. 3, 801-810 (Mar 1974). (In Russian).

Experiments are described which were performed with the purpose of checking the results obtained by Weber in a search of gravitational radiation bursts in the cosmos. In contrast to Weber no coinciding bursts from two independent gravitational antennas separated by a distance of ~20 km were observed. From the measurements of gravitational radiation pulses with a frequency of at least one per 24 hour day it follows that the permissible spectral energy density does not exceed $H(\omega) \approx 10^5$ erg/cm^2 cycles near a frequency 1640 c/s. Recalculated for the center of the Galaxy the energy of one such pulse of duration τ cannot exceed $[5 \cdot 10^{-3}/\tau] M_\odot c^2$. Besides repetition of the Weber experiment a scheme of statistical analysis of the data is developed which is necessary for observation of random bursts. This procedure may be employed in future experiments of this type of higher sensitivity. Some remarks on the possibility of increasing the sensitivity of gravitational antennas are made. (auth)

7850 NEW WAY OF CONSTRUCTING THE COMPLETE SAMPLE OF RADIO SOURCES WITH KNOWN REDSHIFTS. Soltan, A. (Inst. of Astronomy, Warsaw). Acta Astron.; 23: No. 4, 311-318(1973).

A comprehensive sample of radio sources with known redshifts is constructed. Optical and radio selection limits are replaced by their linear combination. The sample, consisting of both quasars and galaxies and numbering 91 objects, is shown to be nearly complete. (IAA) (auth)

7851 DELAYED RESPONSE TO SUGGESTIONS OF AN EXPANDING UNIVERSE. Hetherington, N. S. J. Brit. Astron. Ass.; 84: 22-28(Dec 1973).

By 1916 two static models corresponding to solutions of Einstein's field equations had been found. Eventually it was realized that neither system was compatible with observations. The expanding model of the Universe proposed by Lemaitre (1930) could account for the observational data and provide a satisfactory resolution of the crisis following from the failure of the two static models. (IAA)

7852 BLACK HOLE EXPLOSIONS. Hawking, S. W. (Cambridge Univ., Eng.). Nature (London); 248: No. 5443, 30-31(1 Mar 1974).

It is stated that quantum gravitational effects are usually ignored in calculations on the formation and evolution of black holes, the justification for which is that the radius of curvature of space-time outside the event horizon is very large compared with the Planck length. This means that the energy density of particles created by the gravitational field is small compared to the space-time curvature. Even though quantum effects may be small locally they may still add up to produce a significant effect over the lifetime of the Universe, $\sim 10^{17}$ sec., which is very long compared to the Planck time of $\approx 10^{-43}$ sec. The purpose of this communication is to show that this indeed may be the case. It seems that any black hole will create and emit particles such as neutrinos or photons at just the rate expected if the hole was a body with a temperature dependent on the surface gravity. As the thermal radiation is emitted loss of mass would be expected, and this in turn would increase the surface gravity and hence the rate of emission. The black hole would have a finite life, which for a hole of solar mass is much longer than the age of the Universe. There might, however, have been much smaller black holes formed by fluctuations in the early Universe, and any such holes of mass $<10^{15}$g would by now have evaporated. Near the end of their lives the rate of emission would have been very high, and about 10^{30} ergs would have been released during the last 0.1 sec. This is a rather small explosion by astronomical standards, but is nevertheless equivalent to about one million one M ton H bombs. The way in which this thermal emission arises is considered. (UK)

7853 EVOLUTION OF INHOMOGENEOUS COSMOLOGICAL MODELS. Bonnor, W. B. (Queen Elizabeth Coll., London). Mon. Notic. Roy. Astron. Soc.; 167: No. 1, 55-61(Apr 1974).

It is shown that an open Robertson-Walker (R-W) model can evolve from a variety of initial states. In fact there exist spherically symmetric inhomogeneous models which approach R-W ones at $t \to \infty$, but whose density on an initial space-like surface is an arbitrary function of the radial variable. (auth)

7854 ISOTROPIC UNIVERSE MODELS AND DE-SITTER GEOMETRY. Caviglia, G.; Luzzatto, G.; Massa, E. (Univ., Genoa). Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur.; 107: No. 6, 681-698(1973). (In Italian).

The relation between the space-time V_4 associated with a general cosmological model with constant curvature and the De-Sitter W_4 variety is discussed. The concept of universe of events $E(a_0)$ relative to the origin of the space coordinate is introduced in V_4. The existence of an isometric correspondence between $E(a_0)$ and a suitable subvariety of W_4 is shown. These results are applied to the study of some properties of isotropic models. (tr-auth)

7855 TIME DELAY OF A RADAR WAVE IN A ROTATING SYSTEM. Burcev, P. (Brno Univ.). Phys. Lett.; 47A: No. 5, 365-366(22 Apr 1974).

A modification of the fourth test of general relativity involving the measuring of the time delay of a radar wave propagating along a closed path in a rotating system created by artificial satellites is discussed. (auth)

7856 COSMOLOGY. Sachs, R. K. (Univ. of California, Berkeley). pp 197-236 of Relativity, Astrophysics, and Cosmology. Dordrecht, Netherlands; D. Reidel Publishing Co. (1973).

From proceedings of the summer school; Banff, Alberta (14 Aug 1972).

A detailed review is given of the methods and models used in the development of theoretical cosmology. After briefly discussing the concepts of matter, matter symmetry, and thermal equilibrium, a classification is made of cosmological space-times, and it is shown how photons carry information from distant sources or initial conditions to the observer. The hot Einstein/De Sitter model is considered from a geometric viewpoint, noting how the space-time fits into the above-mentioned classification and then giving a more explicit coordinate version. The evolution of geometry and the thermal history of matter within the framework of the Einstein/De Sitter model are then discussed, and some comments are made on the two extreme cases of complete thermal equilibrium and collision-free propagation. A brief discussion is then made of some of the methods used in trying to analyze lumps in the Universe. Certain features of linearized perturbation space-times are reviewed, and some of the known exact inhomogeneous cosmological models are mentioned. Finally, an application of a homogeneous anisotropic space-time, namely, a Bianchi Type 1 space-time, is demonstrated. (IAA)

7857 LIMIT ON THE REST MASSES FROM BIG BANG COSMOLOGY. Szalay, A. S.; Marx, G. (Roland Eoetvoes Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 35: No. 1-4, 113-129 (1974).

The age of the Universe and the Hubble deceleration of galaxies depends upon the average mass density. The temperature of the electromagnetic background radiation determines also the neutrino particle density. These empirical informations put an upper limit on the rest masses of the neutrinos, which are more restrictive than the laboratory values. (auth)

7858 STATISTICAL ANALYSIS OF CATALOGS OF EXTRAGALACTIC OBJECTS. II. THE ABELL CATALOG OF RICH CLUSTERS. Hauser, M.G. (Joseph Henry Laboratories, Physics Department, Princeton University); Peebles, P.J.E. Astrophys. J. 185: No. 3, 757-785 (1 Nov 1973).

We present the results of a power-spectrum analysis of the distribution of the clusters in the Abell catalog. We find clear and direct evidence of superclusters with small angular scale, in agreement with the recent study of Bogart and Wagoner, and we find that the degree and angular scale of the apparent superclustering varies with distance in the manner expected if the clustering is intrinsic to the spatial distribution rather than a consequence of patchy local obscuration. The observations can be fitted to a spatial covariance function such that the probability of finding a cluster within $20h^{-1}$ Mpc of a randomly chosen cluster is about 10 times the probability for a strictly random distribution (h = Hubble's constant in units of 100 km s^{-1} Mpc^{-1}). The observed small-scale structure corresponds to an average of 2 to 3 clusters per supercluster. Although the distribution of clusters at large angular scale clearly is not uniform, we find no basis on the present evidence for deciding whether this is due to local obscuration or to large-scale ($\sim 600h^{-1}$ Mpc) density irregularities with density contrast on the order of 30 percent (rms). (auth)

7859 FLUCTUATIONS IN THE BACKGROUND X-RAY INTENSITY. Khazan, Y.M. (Moscow Technical Physics Institute). Sov. Astron.-AJ 17: No. 3, 301-303 (Nov 1973).

The intensity fluctuations of the x-ray background are calculated for the case where it is produced by the radiation of unresolved discrete sources. The strong isotropy of the background conflicts with models where the x rays are generated by powerful sources comprising less than 1% of the normal-galaxy population, but even a mild evolutionary effect will remove this restriction. (auth)

7860 NEW LIMIT ON FLUCTUATIONS IN THE PRIMORDIAL BACKGROUND RADIATION OF THE UNIVERSE. Pariiskii, Y.N. (Special Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 3, 291-294 (Nov 1973).

The brightness fluctuations of the universe, averaged over scales of $12' \times 40'$ at 4-cm wavelength, are found to be $1.3 \cdot 10^{-4}$°K. Evidently these fluctuations arise predominantly from weak background radio sources; any fluctuations in the primordial radiation are far smaller than this value. An upper limit $\sigma_{RR}/T_{RR} < 4 \cdot 10^{-5}$ K is obtained on the relative fluctuations in the blackbody radiation. So small a value imposes severe constraints on the energy of large-scale gravitational waves in the universe (their equivalent mass density is less than 8.10^{-36} g/cm^3), and is inconsistent with some versions of the fluctuation and vortex hypotheses for the origin of galaxies and galaxy clusters. (auth)

7861 THE SMALL-SCALE ANISOTROPY OF THE COSMIC LIGHT. Shectman, S.A. (Hale Observatories, California Institute of Technology and Carnegie Institution of Washington). Astrophys. J. 188: No. 2, 233-242 (1 Mar 1974).

We have measured the spatial power spectrum of the faint fluctuations of the nightsky brightness due to distant clusters of galaxies. This spectrum depends strongly on the luminosity density of the Universe and on the covariance structure of the galaxy distribution. Based on the luminosity function for nearby galaxies, we obtain a density contrast $\langle p^2 \rangle / \langle p \rangle^2 = 29$ for galaxy clustering at a correlation length $l = 1$ Mpc. (auth)

7862 AXISYMMETRIC STABILITY OF KERR BLACK HOLES. Friedman, J.L.; Schutz, B.F. Jr. (Yale University, New Haven, Connecticut 06520). Phys. Rev. Lett. 32: No. 5, 243-245 (4 Feb 1974).

A variational expression is used to prove that all axisymmetric modes of the Kerr sequence of rotating black holes are stable. (auth)

7863 RADIO SOURCE COUNTS AND COSMOLOGY. Hoerner, S.v. (National Radio Astronomy Observatory). Astrophys. J. 186: No. 2, 741-766 (1 Dec 1973).

Most authors who have compared source counts with cosmological models agree that evolution is needed and is more important than the choice of the right world model. But there is much disagreement about all possible details; whether density evolution is sufficient, or whether luminosity evolution is needed in addition, or instead; whether all sources evolve, or bright ones only, or quasars only; and so on. A general investigation into the role played by the radio luminosity function Φ (L) gave five results. First, there is a "critical shape," $\Phi \sim L^{-5/2}$. Unfortunately, the data follow this critical shape, within their range of uncertainty, during four powers of 10 in L. The disagreeing results about evolution can be obtained by using slightly different luminosity functions, on the one or the other side of the critical one. The results about details of evolution thus are dominated by the choice of the right luminosity function. Second, the normalized differential counts $n_n(S)$ consist of three parts: a maximum or rather flat-top range at a medium flux S_m, a drop at the bright end, and a steep gradual decrease to faint fluxes; these parts have different meanings. The drop needs evolution such that not the density but the integral over $\Phi_n = L^{5/2}\Phi$ was higher in the past; the location S_m of the maximum depends on the location L_m of the maximum of Φ_n and on the redshift cutoff, and a wide-top of the counts needs a wide-top range of Φ_n and/or a more gradual redshift cutoff. But the decrease to faint fluxes depends more on the luminosity function than on cosmology. Unfortunately, future observational progress will be for faint sources only. Third, because of the wide range of uncertainty of the luminosity function, the steady-state model cannot be ruled out just by the bright end of the source counts. But it is ruled out by counting both the brightest and the faintest sources. Fourth, not only is the expected Hubble relation ($z \sim S^{-1/2}$) blurred by too much scatter; in addition, we find that even the expected slope may have any value (plus, minus, zero) depending on luminosity function and evolution. The most realistic assumptions yield a negative slope only for the brightest fluxes, but a small positive slope for the faint ones (reverse Hubble relation: faint sources are nearby). Whenever the slope is close to zero, source counts have no bearing on cosmology since the average flux then is no distance indicator. This shows the need for including angular structure and spectra in addition to just fluxes and numbers. Fifth, after having finished the evaluation of a source count, one must calculate z(S) for the bright sources and compare with observations. Several otherwise good evolution results had to be rejected after this redshift test. One must find a compromise for fitting both the counts and the redshifts. (auth)

7864 A TIME-SYMMETRIC, MATTER, ANTIMATTER, TACHYON COSMOLOGY. Gott, J.R. III (California Institute of Technology, Pasadena). Astrophys. J. 187: No. 1, 1-4 (1 Jan 1974).

A generalized, time-symmetric, big-bang cosmology is proposed. In big-bang cosmologies the creation of the universe is associated with a singularity or singular region of spacetime. Solutions to the Einstein field equations are given which show that there are three distinct universes naturally associated with such a singularity: (I) our Universe, dominated by matter and lying to the future of the singularity; (II) a time-reversed antimatter universe to the past of the singularity; and (III) a tachyon universe with a spacelike separation from the singularity. (auth)

Planetary Phenomena

7865 (BNL-18808) RADIOACTIVE RARE GASES AND TRITIUM IN THE SAMPLE RETURN CONTAINER, AND THE ^{37}Ar, ^{39}Ar, TRITIUM, HYDROGEN, AND HELIUM DEPTH PROFILES IN THE APOLLO 16 AND 17 DRILL STEMS. Stoenner, R. W.; Davis, R. Jr.; Norton, E.; Bauer, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 39p. (CONF-740321-1). Dep. NTIS $5.00.

From fifth lunar science conference; Houston, Texas, USA (18 Mar 1974).

The gas was extracted from the sample return container from the Apollo 16 and 17 missions by adsorption on charcoal and activated vanadium metal. The hydrogen, argon, and radon were separated and counted to give the tritium, ^{37}Ar, ^{39}Ar, and ^{222}Rn activities. The tritium and argon activities observed could be explained by diffusive losses of these gases from the fine material in the container. There was no excess tritium present in the Apollo 17 containers that could be attributed to solar tritons remaining from the intense flare of August 4, 1972. The ^{222}Rn observed in the sample return container was interpreted as an emanation product from lunar fines and an emanation yield of 1×10^{-4} was calculated. This yield is consistent with the low radon content observed in the lunar atmosphere. The tritium, ^{37}Ar, ^{39}Ar, and ^{222}Rn activities and the K, Ca, Ti, Fe, Mn, hydrogen, and helium contents were measured on a set of samples from the Apollo 16 and 17 deep drill stems at depths from 49 to 472 g/cm^2. The ^{37}Ar and ^{39}Ar activities combined with similar measurements at more shallow depth by Fireman and associates (SAO) in the Apollo 16 drill stems give the complete activity profile in the lunar regolith. Since ^{37}Ar is produced mainly by the ^{40}Ca(n,α)^{37}Ar reaction it is possible to determine the neutron production rate in the regolith as a function of the depth. The ^{222}Rn extracted from the samples by vacuum melting was found to be lower than expected in most of the samples based upon their uranium contents, but in two samples excess ^{222}Rn was observed. The hydrogen and helium contents of the drill stem samples were measured. The helium contents were found to be relatively uniform with depth in the Apollo 16 soil, but increased a factor of two with increasing depth in the Apollo 17 drill stem. The H/He atom ratio was higher than the accepted solar wind value by a factor of two, probably due to water contamination. (auth)

7866 (N-73-25878) RADIATION BELTS OF JUPITER. Degioanni, J. J. C. (Illinois Univ., Urbana (USA)). 1973. 132p. (NASA-CR-132960). NTIS $8.75.

Thesis.

A simplified model of the Jovian magnetosphere consists of thermal plasma with superimposed radiation belts. The model is derived using the following assumptions: (1) The radiation belts are located in a cavity of the Jovian magnetosphere and the field geometry in that cavity is a pure dipole. (2) The conductivity in the Jovian ionosphere is large enough to force the magnetosphere to corotate. (3) The population of electrons in the radiation belts is in a steady state, and the observational data are representative of such average conditions. (4) The nonthermal continuum is produced by the synchrotron radiation of trapped relativistic electrons. (auth)

7867 HELIUM AND HYDROGEN IN THE LUNAR ATMOSPHERE. Hodges, R. R. Jr. (Univ. of Texas, Dallas). J. Geophys. Res.; 78: No. 34, 8055-8064 (1 Dec 1973).

Solar-wind ions impinge on the surface of the Moon, become neutralized, and are subsequently released to become part of the neutral lunar atmosphere. Of the gas species supplied by the solar wind, only helium and hydrogen are light enough to be lost from the Moon by Jeans' thermal escape mechanism. To study the behavior of helium and hydrogen, a Monte Carlo technique was used, in which random ballistic trajectories of individual molecules are traced over a spherical Moon. In the computation, a particle is "created" on the sunlit surface, and the locations of its subsequent encounters with the surface are recorded until it escapes. Global distributions of helium and hydrogen concentrations were computed, based on the hypothesis that the release of neutral gases from the lunar surface is confined to daytime and correlated with the solar-wind influx. The resulting helium model is in good agreement with the measurements from the Apollo-17 lunar surface mass spectrometer. In view of the absence of atomic hydrogen in the lunar atmosphere and the need for a loss mechanism for the solar-wind influx of protons, a molecular hydrogen

atmosphere model is proposed in which predicted amounts of H_2 are below presently established upper bounds. (auth)

7868 ESCAPE OF ^{4}He AND FAST O ATOMS FROM MARS AND INFERENCE ON THE ^{4}He MIXING RATIO. Knudsen, W. C. (Lockheed Palo Alto Research Lab., CA). J. Geophys. Res.; 78: No. 34, 8049-8054(1 Dec 1973).

The dependence of the escape flux of fast O atoms from the upper atmosphere of Mars on the concentration of O and ^{4}He is derived. The escape flux is computed by using the observed electron concentration profile, by assuming the ion composition to be largely O_2^+, and by assuming an exospheric altitude for a pure CO_2 exospheric composition. The dependence of the fast O escape flux on the concentrations of O and ^{4}He is then derived by computing the change in exospheric altitude resulting from addition of these constituents. An O/CO_2 ratio of 0.03 at the ionospheric peak is found to substantially reduce the O escape flux computed assuming a pure CO_2 exosphere, whereas an O/CO_2 ratio as small as 0.005 does not significantly affect the escape rate. This range of the O/CO_2 ratio is that inferred from Mariner ultraviolet results. A ^{4}He mixing ratio in the lower atmosphere exceeding 2×10^{-4} would also suppress the escape flux of O. The concentration of H is too small to affect the loss of O. The escape flux of O atoms will produce an escape flux of ^{4}He by collision. If the O escape flux is unsuppressed, the resulting ^{4}He escape flux exceeds that produced by thermal escape and probably that produced by plasma expansion escape into the solar wind. Lower and upper bounds of the ^{4}He mixing ratio in the lower atmosphere are estimated to be 10^{-9} and 10^{-3}, respectively. (auth)

7869 ION DISTRIBUTION IN MARTIAN ATMOSPHERE. Agarwal, D. C. Indian J. Theor. Phys.; 21: No. 4, 97-108(Dec 1973).

The paper deals with the study of ion distribution in the atmosphere of Mars. All the calculations have been done for all the three models, namely F_2, F_1, and E. Considering photochemical reactions appropriate to the atmosphere of Mars the positive and negative ion distributions are calculated. It is found that the upper atmosphere of Mars is dominated by O^+ ions whereas the lower atmosphere is by CO_3^+ ions. Also, it is found that the number density of negative ions is very small. (auth)

7870 ORIGIN OF THE PLANETS AND SATELLITES. Lewis, J. S. (Massachusetts Inst. of Tech., Cambridge). Technol. Rev.; 76: 20-35(1973).

The approximate time scale of events in the Galaxy indicate that a few billion years passed before the first large-scale formation of the heavy chemical elements, a few billion years more passed before the formation of the solar system, and a few billion more years have passed since then. The study of meteorites and of the Earth itself as an aid in determining the origin of the solar system is discussed. The other bodies in the solar system contribute some useful information. The densities of the planets and satellites reflect their bulk compositions. In addition, the abundance and composition of volatile matter on the planets can be deduced from spectroscopic studies of planetary atmospheres. Chemical equilibrium in the solar nebula, and an equilibrium model for planetary formation are considered, as well as a disequilibrium model. The predictions of these models are compared to what is known about the densities and compositions of the solid bodies in the solar system. (IAA)

7871 HYPERFINE STRUCTURE IN THE RADIO SPECTRA OF JUPITER. Ellis, G. R. A. (Tasmania Univ., Sandy Bay, Australia). Proc. Astron. Soc. Aust.; 2: No. 4, 191-193(Oct 1973).

A series of spectrographic observations with time resolutions in the range 0.3 to 1 ms combined with frequency resolutions between 10 kHz and 2 kHz were made between May and Apr 1972 with the Llanherne low-frequency radiotelescope and recorded on video tape. Illustrations are given of 5 bursts with herringbone bursts, absorption bursts, and lane bursts. (AU)

7872 JOVIAN ATMOSPHERE: STRUCTURE AND COMPOSITION BETWEEN THE TURBOPAUSE AND THE MESOPAUSE. Sagan, C. (Cornell Univ., Ithaca, NY); Veverka, J.; Wasserman, L.; Elliot, J.; Liller, W. Science; 184: No. 4139, 901-903(24 May 1974).

The occultation of the star Beta Scorpii by Jupiter was observed at high-time resolution in three wavelength channels. The results imply a temperature of 220°K at an altitude in the Jovian atmosphere corresponding to 10^{14} molecules per cubic centimeter, and temperature fluctuations of 2° to 10°K over vertical scales of 2 to 10 kilometers. They suggest that the vertical eddy diffusion coefficient near the turbopause has a lower limit of 7×10^5 square centimeters per second, and that the turbopause lies above the altitude where the density is 5×10^{13} molecules per cubic centimeter. Below the turbopause, the ratio of hydrogen to helium is consistent with cosmic abundances. (auth)

7873 HYDROGEN IONIZATION IN THE SHOCK LAYER FOR ENTRY INTO THE OUTER PLANETS. Howe, J. T. (Ames Research Center, Moffett Field, CA). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 12: No. 6, 875-876(Jun 1974).

An assessment is made of the chemical state of the shock layer with respect to the reaction (1) $H \rightarrow H^+ + e^-$ for representative entries into Saturn, Uranus, and Jupiter. A summary of these estimates for entry into the various model atmospheres of the outer planets is shown for both the stagnation region and for the flank of a 60 half-angle cone having a 1-m ray for a warm, nominal warm, and cool Uranus; a warm, nominal, and cool Saturn; and Jupiter. Finite rate chemistry seems to play a role only for entry into the Saturn nominal atmosphere (79% H_2, 20% He) at a fairly steep entry angle (40°). For shallow entry (15°) into that atmosphere, the reaction (1) would probably be frozen. Thus, except for the steep entry into the Saturn nominal atmosphere, the computation of all entry probe gascaps for the outer planets can probably be considered on either a frozen or a chemical equilibrium basis and avoid the complications of finite rate chemistry. (MCW)

7874 ON THE STATUS OF THE ROTATION OF VENUS. Lyttleton, R. A. (Jet Propulsion Lab., Pasadena, Calif. (USA)). Astrophys. Space Sci.; 26: No. 2, 497-511(Feb 1974).

Owing to its extremely slow rotation, Venus must be regarded as a triaxial body with differences of all three principal moments of inertia comparable in magnitude, thus rendering it a body essentially different from a rapidly rotating planet. The dynamical problem then arises of how such a body, with a rotation-period comparable with its orbital period, would be affected by couples exerted upon it by the gravitational action of the Sun. Equations for the rotatory motion are set up in a form suitable for numerical solution by machine-calculations, but the problem so presented can be adequately investigated only for a hypothetical planet with far larger differences of principal moments than could hold for Venus. Results obtained on this limited basis nevertheless suggest that for the actual planet the direction of the rotation axis may move almost randomly between the two hemispheres defined by the orbital plane and thus that the present direction near the south celestial pole of the orbit may be only a temporary situation. Order-of-magnitude considerations based on the equations of motion suggest that a time-scale of order 10^7 to 10^8 yr may on average be required for large changes in direction of the rotation axis to take place. (auth)

7875 FLUX-DENSITY MAPS OF JUPITER'S DECAMETRIC RADIO SOURCES. Miller, H.R. (Department of Physics, Georgia State University, Atlanta); Smith, A.G. Astrophys. J. 186: No. 2, 687-694 (1 Dec 1973).

Nine years of observations of Jupiter's decametric radio emissions are summarized in maps showing average peak flux density as a function of central meridian longitude and the orbital position of Io. It is shown that a simple scale conversion allows the maps to be interpreted as maps of long-term mean flux density. The empirical probability and flux maps are compared with the predictions of recent theoretical models proposed by McCulloch and by Schatten and Ness. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 7587.

7876 REFLECTION MECHANISM OF VLF RADIO WAVES IN THE LOWER IONOSPHERE. Hayakawa, M. (Nagoya Univ., Toyokawa, Japan). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP-21: No. 6, 915-916(Nov 1973).

An examination was made of the reflection mechanism of vlf radio waves in the inhomogeneous-anisotropic lower ionosphere. The full-wave numerical results were compared with the case of the isotropic ionosphere and then with the ray theory concept. (auth)

7877 MICROPULSATIONS IN THE MORNING SECTOR. I. Ground Observations of 10- to 45-Second Waves Tungsten, Northwest Territories, Canada. Arthur, C. W.; McPherron, R. L.; Coleman, P. J. Jr. (Univ. of California, Los Angeles). J. Geophys. Res.; 78: No. 34, 8180-8192(1 Dec 1973).

A study of several 10- to 45-sec wave events in the morning sector at Tungsten, Northwest Territories, Canada (approximately at the foot of the ATS 1 field line), reveals that at least two distinctly different types of wave phenomena occur. Digital power spectral and coherency analysis was used to determine the average characteristics of the two types of waves. The first, identified as Pi 1, is characterized by a broad-band spectral enhancement with an average center frequency of ~0.07 Hz (~14 sec), nearly linear E–W polarization, and a close association with substorms. The second type, Pc 3, is characterized by narrow spectral lines at an average frequency of ~0.04 Hz (~27 sec), nearly linear N–S polarization, and no close association with substorms. Although these two types of wave activity occur in the same local time sector, sometimes simultaneously, there is no indication of any relationship between them. (auth)

7878 THEORETICAL MODELS FOR ELECTRON ENERGY RELAXATION IN THE LOWER IONOSPHERE. Hagenbuch, K. M. (Pennsylvania State Univ., University Park). J. Geophys. Res.; 78: No. 34, 8345-8350(1 Dec 1973).

Elastic collisions and rotation inelastic collisions involving quadrupole molecular transitions are important in energy relaxation of electrons in molecular gases. It has been customary in studying the cooling of electrons in a plasma heated by high-frequency waves to characterize this relaxation by the ionospheric G factor. The G factor is first defined in a fundamental way by use of kinetic theory. Then present models for theoretical cross sections for electron collision with O_2 and N_2 are used to derive expressions for the G factor in the lower ionosphere. Two models are considered: one uses Gerjuoy–Stein models for both N_2 and O_2; the other uses a Gerjuoy–Stein model for N_2 and a Geltman–Takayanaki model for O_2. Neither O_2 model has been definitely established experimentally. It is found that temperature dependence of G is critically dependent on the O_2 model. (auth)

7879 GEOMAGNETIC SECULAR CHANGE, 1964–1970, FROM SATELLITE F AND OBSERVATORY X, Y, AND Z. Hurwitz, L.; Knapp, D. G.; Fabiano, E. B.; Peddie, N. W. (National Oceanic and Atmospheric Administration, Boulder, CO). J. Geophys. Res.; 78: No. 34, 8351-8355(1 Dec 1973).

A global model of the geomagnetic secular change consisting of 195 internal spherical harmonic coefficients (SHC) has been derived. The coefficients $\dot{g}_n^m$, $\dot{h}_n^m$ (to degree n = 13 and order m = 13) were assumed to be constant over the interval 1964–1970. The data for the spherical harmonic analysis consisted of values of scalar intensity secular change $\dot{F}_p$ computed from a recent Pogo model for 648 points at altitude 800 km and values of vector secular change $\dot{X}$, $\dot{Y}$, and $\dot{Z}$ computed from the annual means at 136 observatories. The root means of weighted squared residuals for $\dot{F}_p$, $\dot{X}$, $\dot{Y}$, and $\dot{Z}$ were, respectively, 2.1, 3.9, 3.2, and 3.2 nT/yr (1 nT = 1 nanotesla, equivalent to 1 γ). A model of 80 SHC fitted to the same data fits the $\dot{F}_p$ values almost as well but is less satisfactory for $\dot{X}$, $\dot{Y}$, and $\dot{Z}$. (auth)

7880 POLARIZATION OF THE 584- AND 304-ANGSTROM EMISSIONS OF HELIUM IN THE GEOCORONA AND INTERPLANETARY MEDIUM. Kumar, S.; Bowyer, S.; Paresce, F. (Univ. of California, Berkeley). J. Geophys. Res.; 78: No. 34, 8065-8077(1 Dec 1973).

The polarization of the 584- and 304-A emissions of helium that have been resonantly scattered in the Earth's atmosphere and in the interplanetary medium is discussed. It is shown that in the geocorona the simultaneous measurement of altitude profiles of the 584-A He dayglow intensity and polarization will test the hypothesis that the 584-A dayglow is excited by resonance scattering of sunlight from geocoronal helium. If this is indeed the major source of the 584-A dayglow emission, a simultaneous measurement of the polarization and the altitude profile of the intensity will provide data on the helium optical depth above the altitudes where these measurements are made. In the exosphere this measurement will uniquely determine the helium number density distribution as a function of altitude, and in the thermosphere it will allow a study of nondiffusive equilibrium processes. An attractive feature of this method is that the interpretation does not require a knowledge of the solar 584-A line center flux or line profile. Once the helium number density distribution is obtained, an absolute intensity measurement of the dayglow emission will provide a measure of the solar 584-A line center flux. A polarization measurement of the diffuse 584-A radiation from the interplanetary medium will provide data on the distribution of the scattering helium atoms in this region. Expected polarization results are given for two theoretical models for neutral helium in the interplanetary medium: an interplanetary dust model and an interstellar backscatter model. A polarization measurement of the 304-A airglow emission will assist in separating the plasmaspheric and possible interplanetary components of this radiation and thus may provide information regarding the distribution of helium ions in the plasmasphere and interplanetary medium. (auth)

7881 HYDROGEN EMISSION AND ELECTRON AURORA AT THE ONSET OF THE AURORAL BREAKUP. Oguti, T. (Tokyo Univ.). J. Geophys. Res.; 78: No. 31, 7543-7547 (1 Nov 1973).

The behavior of the auroral arc is examined at the breakup with the aid of the meridian scanning photometer records of the 5577 A and Hβ emissions at the Antarctic Syowa station. The instrument allows for examination of the fine structure of both electron and proton auroras with the angular resolution of 3 degrees. Development of the electron aurora and hydrogen emission during the auroral breakups of May 1–2 and May 18–19, 1971 is followed schematically and photographically. (MCW)

7882 ANOMALIES OF THE MEAN MONTHLY AIR TEMPERATURE OVER THE NORTHERN HEMISPHERE IN DIFFERENT PHASES OF THE 11-YEAR AND CENTURY CYCLES OF SOLAR ACTIVITY. Polozova, L. G. Tr. Gl. Geofiz. Observ.; No. 299, 47-51(1973). (In Russian).

The change in the size and sign of the deviation from the normal mean temperature in the northern hemisphere is examined as a function of the phase of the 11-year and century cycles of solar activity. It is established that the most regular distribution of these deviations occurs in Greenland and the adjacent polar regions in the winter. They are positive at high and negative at low century levels of solar activity and are independent of the 11-year cycle. In the territory of the USSR there are regions and months when the deviations of temperature in one of the phases has a high statistical significance and can be used for the prediction of the multi-year pattern of the monthly temperatures. (tr-auth)

7883 NEGATIVE ION EFFECT ON THE CHERENKOV RADIATION FROM MAGNETOPLASMA. Agarwal, D. C. (Allahabad Univ., India). J. Inst. Eng. (India); 53: 205-206(Jul 1973).

The power radiated by Cherenkov process from the earth's ionosphere has been calculated taking into account the effects of negative ions. The calculations are made for frequencies radiated in vlf and elf banks at mid latitudes during normal days. The calculation shows that the presence of negative ions reduces the radiated power in the elf band while it has little effect on the upper end of vlf region. (auth)

7884 THEORY OF NOCTURNAL ELF EMISSIONS. Yu, M. Y. (Umea Univ., Sweden); Ong, R. S. B. Metal Sci. J.; 9: 67-68(Jan 1974).

Development of an interpretation of continuous nocturnal sub-elf emissions observed in the frequency range from 0.1 to 0.8 Hz is considered. It is shown by means of a simplified ionospheric model that these nocturnal sub-elf emissions may be attributed to unstable drift waves originating from the nighttime E region of the ionosphere. (IAA)

7885 SATELLITE MEASUREMENTS OF SOLAR X-RAY FLUX AND GROUND OBSERVATIONS OF SUDDEN IONOSPHERIC DISTURBANCES. Lastovicka, J.; Smilauer, J. (Ceskoslovenska Akademie Ved, Prague). Geofys. Sb.; 19: 305-316(1971).

Processes controlling the ionospheric D-layer are reviewed, especially those that are the cause of anomalous conditions of

radiowave propagation (SID-events). Attention is paid to the effect of solar x-ray flux, the intensity of which was measured in several energy bands in the period of September through December 1969 using the data telemetered from the Solrad-9 satellite. The satellite equipment and the device for the reception and evaluation of the telemetry information are described. The events of enhanced intensity of solar x rays confirm the dominating effect of x rays upon the lower ionosphere only for x-ray fluxes exceeding a level of about 10^{-13} Wm^{-2} s^{-1} in the 1 to 8 Å band. (auth)

7886 GREEN OXYGEN LINE 5577 A IN THE MEDIUM E-F AND F REGIONS DURING THE NIGHT. Gogoshev, M. M. (Astronomical Observatory, Stara Zagora, Bulgaria). Pure Appl. Geophys.; 111: No. 10, 2300-2307(1973).

7887 EXTERNAL GEOPHYSICS: LAUNCHING OF ROCKET-PROBES FROM THE KERGUELEN ISLANDS. Etcheto-Sterne, J. (CNRS, Saint-Maur-des-Fosse, France). Rech. Spatial; 12: No. 6, 5-8(Nov 1973). (In French).

Rockets (DRAGON) were launched in March and April 1968 from the Kerguelen islands in order to study wave-particle interactions in the magnetosphere. Comparisons made on-board these rockets and on the ground enabled the effect of the ionosphere on the amplitude and wave-propagation time to be studied. Simultaneous measurements of the characteristics of vlf waves and electrons led to an experimental verification of the quasi-linear theory of gyroresonance interactions. Only hiss phenomena were studied. (auth)

7888 EXTERNAL GEOPHYSICS: FR-1 PROGRAM. Cerisier, J. C. (CNRS, Saint-Maur-des-Fosses, France). Rech. Spatial; 12: No. 6, 2-5(Nov 1973). (In French).

The FR-1 experiment enabled the propagation of artificial vlf waves to be studied together with the medium in which they were propagated. Emphasis is given to the determination of irregularities in the ionization distribution from the effects produced on vlf waves. (auth)

7889 DEFOCUSING OF VLF WAVES IN THE MID-LATITUDE TROUGH REGION OF THE UPPER IONOSPHERE. Malingre, M. (CNRS, Saint-Maur-des-Fosses, France). Ann. Geophys.; 29: No. 2, 239-262(Apr 1973). (In French).

Measurements made from the FR-1 satellite at an altitude of 750 km to the north of the Sainte-Assise transmitter, indicate a sharp drop in the vlf field strength for values of the McIlwain L parameter between 3 and 5. Analysis of vlf and local electron density data revealed the existence of a strong correlation between the drop in the vlf field strength and the midlatitude electron-density trough. A theoretical horizontal vlf power distribution was calculated for an altitude of 750 km from ray traces through ionospheric models fitted to local electron-density measurements. The good agreement between experimental and theoretical results demonstrates that the fall in vlf field strength is due to a defocusing of the rays produced by the strong horizontal electron-density gradients associated with the trough. (auth)

7890 NONLINEAR RESONANT EXCITATION OF WHISTLER MODE WAVES IN THE EARTH'S IONOSPHERE. Martelli, G.; Giles, M.; Christiansen, P. (Univ. of Sussex, Brighton, Eng.). Space Sci. Rev.; 15: No. 6, 891-898(May 1974).

An examination was made of the resonant nonlinear interaction in the Earth's ionosphere of two powerful high frequency radio beams with frequencies f_1 and f_2 (both larger than the plasma frequency at $F2_{max}$) and wave numbers k_1 and k_2 such that a whistler-mode wave can be excited with a frequency $f_3 = f_1 - f_2$ and a wave number $k_3 = k_1 - k_2$. The feasibility of an effective ground-based installation, sited at low latitudes, is discussed and the field strength of the wave emerging from a 10-km wide ionospheric region illuminated by the beams is evaluated for a range of transmitted frequencies, beam orientations, and plasma frequencies in the interaction region. It is suggested that the longitude dependence of the enhancement of vlf noise bands detected by the Ariel 3 satellite may be due to a nonlinear interaction of this type between any two or more medium wavelength signals from areas where there is a high concentration of commercial broadcasting stations, such as the NE region of the U.S.A. (auth)

7891 OCCURRENCE OF OPPOSITE ELECTRON DRIFT IN E AND F REGIONS OF THE EQUATORIAL IONOSPHERE AT THE SAME TIME OF THE DAY. Misra, R. K. (Physical Research Lab., Ahmedabad, India). Indian J. Phys.; 47: No. 10, 629-631 (Oct 1973).

It was shown previously that E and F region electron drifts are predominantly westward during the day and eastward during nighttime with changeover taking place around 06 h in the morning and between 19 h to 20 h in the evening. Records from 1968-69 revealed the existence of a few cases where the drifts of the electrons in the two regions are in the opposite direction and the time interval was too short to have resulted in a natural reversal of the direction. Simultaneous records taken at two independent multichannel receiving systems using the same frequency to get reflections from both regions also showed opposite drift of electrons at the two levels. (MCW)

7892 EFFECT OF SOLAR FLARES ON THE INTENSITY OF 5577 A LINE OF NIGHT AIR GLOW. Singh, J.; Chatterjee, S. D. Indian J. Phys.; 47: No. 10, 631-634(Oct 1973).

The oxygen green-line emission λ5577 Å in the night airglow was examined during solar flares as observed at Kodai Kanal, India from January 1968 to May 1969. The effects of solar flares on the emission intensity were analyzed. Electromagnetic radiation like uv and x rays emitted during a solar flare may obviously cause a quicker increase in the relative intensity during the same night. Solar-flare effects on the emission intensity seem to be partly due to electromagnetic radiations and partly due to the particle flux emanated during the solar flare. (MCW)

7893 INVESTIGATION OF WAVE–PARTICLE INTERACTIONS AND PARTICLE DYNAMICS USING ELECTRON BEAMS INJECTED FROM SOUNDING ROCKETS. Winckler, J. R. (Univ. of Minnesota, Minneapolis). Space Sci. Rev.; 15: No. 6, 751-780(May 1974).

Electrons with energy up to 40 kV were injected into semi-trapped orbits from sounding rockets at Wallops Island, Virginia, and at Fort Churchill, Manitoba, Canada. By directing the rocket trajectory to have a horizontal component that in direction and speed matched the bounce displacement of the injected electrons, it was possible to detect conjugate echoes at Wallops and possibly at Churchill, and to study the distribution of the echoes in space, time, and energy. By combining observations of many echoes, a composite picture can be obtained of the beam patterns. Atmospheric scattering at the conjugate point of Wallops island was extensively studied, and the process produces a scale width of 5 to 10 m, but with an echo intensity that is only 10% of theoretical estimates. In the Wallops experiments, a doublet hump appeared in the echoes that is not understood. Models of the magnetic fields are used to predict the bounce displacement, and by comparison with the observations to evaluate other effects such as electric-field drift integrated over a complete bounce period. Preliminary evaluation of the Churchill results indicate the presence of substantial residual effects, which may be electric-field drifts. The artificial beam injection was observed to change natural electron precipitation in the 20 to 40 keV range. The process of rocket neutralization, beam-beam interactions, and electromagnetic radiation from the beams was studied and was part of the Echo program. (auth)

7894 INTERACTION BETWEEN WHISTLERS AND QUASI-PERIODIC VLF EMISSIONS. Ho, D. (Stanford Univ., CA). J. Geophys. Res.; 78: No. 31, 7347-7356(1 Nov 1973).

Quasi-periodic (QP) vlf emissions are noise bursts repeated at intervals of the order of 30 sec. This period is substantially longer than the ~2-sec two-hop whistler-mode travel time along the associated magnetospheric field-aligned paths. New details of QP emissions, particularly on interactions between whistlers and QP activity, have been found in a study of vlf recordings from Eights, Antarctica (L ~ 4), during the period November 1964 to October 1965. The occurrence statistics show that QP emissions favor the equinoxes, later afternoon hours, and quite geomagnetic conditions. Emission frequencies generally lie between ~1.5 and 4 kHz. Detailed studies of broad band vlf spectra show that QP emissions are strongly affected by whistlers. Whistlers often disrupt well-behaved QP patterns by suddenly increasing the QP period, by terminating the emission altogether, or by modifying the fine structure of QP bursts (this fine structure frequently consists of periodic vlf emissions and/or vlf chorus elements). Whistlers can sometimes initiate QP emissions by modulating multiphase periodic emissions. When there are strong interactions between QP emissions and whistlers, QP emissions and whistler echo trains have the same time rate of change of upper cutoff frequency. This evidence of complex connections among various types of vlf signals in the magnetosphere adds a new dimension to recent discoveries of transient whistler-induced precipitation of particles into the ionosphere. (auth)

7895 ELECTRON DENSITY AND TEMPERATURE CHANGES IN THE EQUATORIAL IONOSPHERE DURING MAGNETIC STORMS. Jonwa, T. B.; Davies, K. (National Oceanic and Atmospheric Administration, Boulder, CO). J. Atmos. Terrest. Phys.; 36: No. 6, 1071-1078(Jun 1974).

Storm changes in the height profiles of electron density and electron temperature near the dip equator are presented for five F2-region storms. In all five storms the electron temperature

increased although the electron density may increase or decrease. On the assumption that, at night, the electron and neutral temperatures are equal it is found that the temperatures agree, within 20 per cent with the temperatures calculated from the 1966 U. S. Standard Atmosphere. (auth)

7896 ACCURACY AND RESOLUTION OF MODEL IONOSPHERES DERIVED FROM VLF PROPAGATION PARAMETERS. Bailey, R. C.; Jones, T. B. (Shell Development Co., Houston, TX). J. Atmos. Terrest. Phys.; 36: No. 6, 1059-1069(Jun 1974).

An inversion technique is outlined for calculating the resolution and gross error associated with D-region electron density profiles obtained by modelling from a given set of vlf radiowave propagation parameters. Two profiles, representing quiet and disturbed ionospheric conditions, are examined in detail and the height resolution and accuracy obtainable from the amount of observational data used in constructing these profiles is determined. (auth)

7897 EXTERNAL GEOPHYSICS: HIGH ALTITUDE EXPERIMENTS. Reme, H. (Univ., Toulouse). Rech. Spatial; 12: No. 6, 8-13(Nov 1973). (In French).

Three rockets were launched in order to determine the characteristics of auroral particles. The launchings were made in Andoya (Norway) and Kiruna (Sweden). The first rocket probe was launched into a diffuse aurora characteristic of the recovery from a magnetospheric substorm; the second rocket traversed a structured aurora at the beginning of the substorm expansion phase; the third rocket traversed an aurora moving very rapidly towards the west. Results on the angular distributions of the auroral electrons and the variations in the electron flux with time are given. The results of experiments in which a series of balloons was launched into auroral and sub-auroral zones (conjugate points: USSR-Kerguelen) for studies of the characteristics of the x rays emitted in electron precipitations are also given. The differential flux curves of high-altitude solar protons obtained from rocket probes launched from the Antarctic Dumont d'Urville station are presented. (FR)

7898 BACKSCATTER RESULTS FROM LINDAU. I. Observations of Radio-Auroras. Czechowsky, P.; Dieminger, W.; Kochan, H. (Max-Planck-Inst. fuer Aeronomie, Lindau, Ger.). J. Atmos. Terrest. Phys.; 36: No. 6, 955-966(Jun 1974).

Hf and vhf backscatter measurements carried out in Northern Germany and Scandinavia (ϕ = 55° to 70°) from 1963 to 1971 were analysed and are now presented comprehensively. The daily and seasonal frequency distributions of auroral backscatter echoes are derived as well as the correlation between auroral occurrences and geomagnetic disturbances and the dependence of the echo amplitude on geomagnetic latitude. By means of a calculated equivalent current system the relation between the backscatter occurrences at different stations and the extension and strength of the polar electrojet have been investigated. All observed events when combined in a synoptic graph as a function of time and geomagnetic latitude show a spiral type structure. In addition to auroral backscatter results the daily and seasonal variation of E_s-scatter and 2 × F2 ground backscatter events are presented. (auth)

7899 OBSERVATION OF PERIODIC IONOSPHERIC DISTURBANCES USING SIMULTANEOUS FARADAY ROTATION AND ANGLE OF ARRIVAL MEASUREMENTS. Webster, A. R.; Lyon, G. F. (Univ. of Western Ontario, London). J. Atmos. Terrest. Phys.; 36: No. 6, 943-954(Jun 1974).

Observations of periodic fluctuations in electron content are complemented by simultaneous observations of fluctuations in the angle of arrival of the signal. It is shown that the phase and amplitude relationships between those two sets of fluctuations can provide considerably more information on the nature of the disturbances. In the case of a travelling disturbance estimates of the horizontal wavelength and direction of travel may be obtained at a single observing station. The method also provides an indication of whether or not the observed disturbances are in fact travelling, a matter of some importance in interpreting periodic ionospheric fluctuations in terms of atmospheric gravity waves. Examples are given of which some confirm the presence of a travelling atmospheric wave and some do not. (auth)

7900 COMBINED USE OF SATELLITE DIFFERENTIAL DOPPLER AND GROUND-BASED MEASUREMENTS FOR IONOSPHERIC STUDIES. Evans, J. V. (Massachusetts Inst. of Tech., Lexington); Holt, J. M. IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP-21: No. 5, 685-692(Sep 1973).

The use of satellite differential Doppler measurements to study latitudinal variations of F-region electron density is described. It is shown that the ambiguity in the total phase path length may be resolved employing either incoherent scatter radar measurements or vertical-incidence ionosonde data, together with some assumptions concerning east-west gradients at the latitude of the observing station. Sample results are given showing the location of the midlatitude trough of electron density observed at Millstone Hill through observations of the U. S. Navy Navigation Series satellites. (auth)

7901 GEOMAGNETIC FIELD OF EXTERNAL ORIGIN AS OBSERVED AT THE EARTH'S SURFACE. Zmuda, A. J. EOS, Trans., Amer. Geophys. Union; 55: No. 6, 588-599(Jun 1974).

The basic physics, the configuration of the sources, and the local time variations are discussed in reference to the external origin of the geomagnetic field from Earth-surface observations. The magnetic field at and near the Earth's surface resembles the field from a strong magnet located at the Earth's center and believed due to electric currents flowing in the molten material forming the Earth's core and that the interaction among the field, currents, and material form a dynamo that sustains the geomagnetic field. Additional discussions from the April 16-20, 1973 meeting of the AGU on the geomagnetic field include papers on Magnetospheric Sources, Ionospheric Sources, Auroral-Polar Currents, and Effects of Induction in the Earth upon Measurements of External Time-varying Magnetic Fields. (MCW)

7902 IMPULSE RESPONSE OF A COLD STRATIFIED PLASMA IN THE PRESENCE OF COLLISIONS AND A VERTICAL MAGNETIC FIELD BY A MULTIPLE-SCATTERING TECHNIQUE. Gray, K. G.; Bowhill, S. A. (Univ. of Illinois, Urbana). Radio Sci.; 9: No. 5, 559-566(May 1974).

The multiple-scattering technique is extended to include the effects of simple collisions and a vertical magnetic field on the impulse response of a stratified cold plasma. In this case as in the free-electron case it is possible to formulate a multiple-scattering integral for the nth scattered field in terms of the (n−1)th scattered field. The total response is the sum over all orders of scatter. By an appropriate convolution process it is possible to find the nth scattered field in the presence of collisions and a magnetic field from the corresponding scatter for the free-electron case. This method is used to find the response of an infinite region of exponentially increasing electron density and a half space of uniform electron density in the presence of collisions and a magnetic field. (auth)

7903 CERTAIN BEHAVIOR OF THE IONOSPHERIC F_2 REGION AT LOW LATITUDES. Huang, C. M. (Kyoto Univ.). Radio Sci.; 9: No. 5, 519-532(May 1974).

The continuity equation of electron density is solved for the conditions of the F2 region at low latitude along 69°W meridian in the equinox of high solar activity. The transport term includes the electromagnetic drift observed at Jicamarca, the plasma diffusion, the vertical motion due to thermal expansion and contraction, and the neutral wind for which the direction reversal in the morning is rather late. The large-scale irregularity that forms a bifurcated F2 layer is generated at the geomagnetic equator and travels as far as 15° latitude with a speed of about 10 km min^{-1}. Other features of this bifurcation and the probable mechanism of its formation are described. The height of maximum electron density is strongly controlled by the electromagnetic drift at very low latitude from 0700 to midnight. The computation also shows that the large postsunset peak of $N_m F2$ at a subtropical region is caused by the rapid sunset increase of upward drift at the equator. The late reversal of neutral wind favors the observed diurnal pattern of $N_m F2$. Other effects of neutral wind and that of loss rate on the low latitude ionosphere are discussed. (42 references) (auth)

Magnetospheric Phenomena

Refer also to abstracts 6302, 7887, 7888, and 7901.

7904 (N-73-17498) RESPONSES OF THE THERMOSPHERE DUE TO A GEOMAGNETIC STORM: A MHD MODEL. Interim Report. Wu, S. T.; Chang, S. C. (Alabama Univ., Huntsville (USA). School of Graduate Studies and Research). Dec 1972. Contract NAS8-25750. 44p. (NASA-CR-124071; UAH-122). NTIS $4.25.

A magnetohydrodynamics theory was used to study the dynamic response of the neutral atmosphere to a geomagnetic storm. A full set of magnetohydrodynamic equations appropriate for the present problem is derived and their various orders of approximation are discussed in some detail. In order to demonstrate the usefulness of this theoretical model, the May 1967 geomagnetic storm data were used in the resulting set of nonlinear, time dependent, partial differential magnetohydrodynamic equations to calculate variations of the thermosphere due to the storm. The numerical results are presented for wind speeds,

electric field strength, and amount of joule heating at a constant altitude for the data recorded. Data show that the strongest thermospheric responses are at the polar region becoming weaker in the equatorial region. This may lead to the speculation that a thermospheric wave is generated in the polar region due to the geomagnetic storm which propagates towards the equator. (auth)

7905 (N-73-31367) ANALYSIS OF AURORAL PARTICLE FLUXES. Final Report. Chappell, C. R. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). 1 Aug 1973. Contract NASw-2212. 76p. (NASA-CR-133889). NTIS $6.00.

The study is reported of electron and proton precipitation in different auroral forms from data obtained by the TWINS 1 and 2. The measurement of the energy spectra and pitch angle distributions of auroral electrons is discussed along with the auroral electron code for predicting the scattering and energy loss of electrons covering the complete auroral energy spectrum. (STAR)

7906 COMPUTER SIMULATION OF COLD PLASMA EFFECTS ON THE WHISTLER INSTABILITY FOR GEOSTATIONARY ORBIT PLASMA PARAMETERS. Cuperman, S. (Univ. of Colorado, Boulder); Salu, Y. J. Geophys. Res.; 78: No. 31, 7372-7387(1 Nov 1973).

The results are presented of a computer simulation of the modifications produced in the whistler instability by the addition of varying amounts of cold plasma to an infinite homogeneous warm (w) plasma with parameters typical of those observed in the equatorial magnetosphere beyond the plasmapause ($\beta = 4\pi n_w kT_{\|,w}/B^2 = 0.8$ and $(T_\perp/T_\|)_w = 2$). Specifically, the particle-in-cell simulation method for electromagnetic interactions in infinite homogeneous magnetized plasmas has been used. The experiment has been performed for three values of relative cold (c) plasma concentrations, $n_c/n_w = 1$, 2, and 5; prior results for $n_c/n_w = 0$ are also discussed. The results of the experiment confirm the basic predictions of theoretical linear stability analysis for the prescribed conditions. In the linear stage of evolution the addition of cold plasma (1) increases the instability range in k space and thus enables resonant interactions of electrons having lower parallel velocities and (2) displaces the k location of the maximum rate of growth toward larger k values. Additional quasi-linear effects indicate that as a consequence of particle diffusion in velocity space the thermal anisotropy ratios $(T_\perp/T_\|)_w$ decrease continuously, the result being a decrease of the larger k mode growth rates and a displacement of maximum wave amplitude toward smaller k values. All the systems relax to quasi-stationary states with approximately the same $(T_\perp/T_\|)_w$ value, ≈1.35 (that linearly should be unstable). However, in this stage, the larger the initial n_c/n_w ratio, the larger the total energy in the electromagnetic waves. (auth)

7907 CHERENKOV-CYCLOTRON POWER GENERATED IN THE MAGNETOSPHERE BY NATURAL AND ARTIFICIAL INJECTION OF ELECTRON BEAMS. Singh, R. P. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). Ann. Geophys.; 29: No. 2, 227-238(Apr 1973).

The comparative features of electromagnetic radiation from Cherenkov and Doppler shifted cyclotron radiation (normal and anomalous) processes are studied from natural emissions and artificially injected beams in the ionosphere. The total power incoherently radiated from the injected beam is calculated by multiplying the test charge particle power by the number of electrons injected into the ionosphere. The detailed characteristics of the radiated wave are given for frequencies lying between the lower-hybrid and upper-hybrid frequencies. The effect of plasma density and composition on the radiated power is discussed. Studies of the polarization of the radiated waves show that a single antenna with its axis perpendicular to the magnetic field direction is sufficient in most cases and that the radiated waves are almost electrostatic in nature throughout most of the frequency range. The flux radiated by natural emissions is calculated by multiplying the test charge particle by the particle distribution function (electrons) and integrating over the energy and pitch angle limits. The effect of the exponential energy spectrum parameter on the radiated flux is explained. It is also shown that the radiated incoherent power is insufficient to explain the experimental observations. The importance of individual radiation in magnetospheric dynamics is indicated. (FR)

7908 VARIATION OF LUNAR AND SOLAR GEOMAGNETIC TIDES WITH SUNSPOT AND GEOMAGNETIC ACTIVITY. Rao, K. S. R.; Reddy, S. J. (Meteorological Office, Poona). Pure Appl. Geophys.; 111: No. 10, 2291-2299(1973).

Solar and lunar geomagnetic tides in H at Alibag were determined by spectral analysis of discrete Fourier transforms following the method of Black and the well-known Chapman–Miller method. The seasonal variation in L2(H) is opposite to that in L2(D), with maximum in the d season and minimum in the j season. In both H and D, the enhancement due to sunspot activity is larger in lunar tide than in solar tide. Surprisingly, the enhancement due to magnetic activity is greater in L2(H) than in S1(H), while the contrary is true for declination. It is inferred that there is a local time component of the storm time variation contrary to the view expressed by Green and Malin. The enhancements in amplitudes L2 and S1 in H and D, due to sunspot activity and due to magnetic activity, were separated. (IAA)

7909 LOCAL TIME DEPENDENCE OF AMPLITUDE AND PHASE OF ANNUAL AND SEMIANNUAL COMPONENTS IN H. Yacob, A. (Indian Inst. of Geomagnetism, Bombay). Pure Appl. Geophys.; 111: No. 10, 2319-2323(1973).

Using the monthly mean diurnal inequalities of Colaba horizontal force for each of the 24 local hours given by Moos, the amplitudes of the sine and cosine terms of the annual and semiannual components and their mean errors were obtained by the application of the least-squares method and solution of simultaneous equations. The annual-component amplitude is largest for 13 hours and the epoch of maximum for most of the sunlit hours is in May. The semiannual component attains large amplitude during the forenoon hours, while its epoch of maximum shows considerable variation. A discontinuity is observed around 18 hours in the trend of change in amplitude and phase of both components, suggesting the effect of partial ring currents.(IAA) (auth)

7910 LABORATORY EXPERIMENTS OF MAGNETOSPHERIC INTEREST. Faelthammar, C. G. (Royal Inst. of Tech., Stockholm). Space Sci. Rev.; 15: No. 6, 803-825(May 1974).

Space-related laboratory experiments can play an important role as a complement to observations and active experiments in the magnetosphere. Two major experimental types: (1) partial scale model experiments and (2) experiments for clarifying basic plasma physical processes known or expected to be important in the magnetosphere (but without the ambition to simulate actual space configurations) were performed. The limitations and potentialities of both types are discussed and examples of experiments are given. It is concluded that there should be an increasing need for the experiments of the second type. In particular, they are needed for the clarification of the response of a thin plasma to electric fields and its ability to carry electric currents. This encompasses such key questions as the nature and role of "anomalous" resistivity (and electron runaway in its presence), the possible formation of double layers (and the acceleration processes associated with them), and rapid dissipation of magnetic-field energy. 74 references. (auth)

7911 MAGNETOSPHERE DYNAMICS WITH ARTIFICIAL PLASMA CLOUDS. Cornwall, J. M. (Univ. of California, Los Angeles). Space Sci. Rev.; 15: No. 6, 841-860(May 1974).

Addition of cold plasma to the magnetosphere outside the plasmasphere can enhance both ion and electron electromagnetic cyclotron (EMC) instabilities. The ion EMC mode is turned on by a cold plasma ion that is not too heavy; in many respects, lithium is ideal. Calculations have been made of total ion-EMC amplification on a single pass through a lithium cloud; these show that as much as 40 to 80 dB gain can be achieved on a synchronous-orbit field line. The most important effects of adding lithium are to reduce the minimum anisotropy requirement considerably, and to broaden the unstable domain in k-space. The dynamics of the cold lithium cloud have been studied in detail; on a time scale of a few hours, the cloud behaves as an incompressible fluid in the presence of electric convection fields, and should not become so seriously distorted that the total amplification given above is substantially degraded. Some remarks are made about the effects of added cold plasma on the Post-Rosenbluth electrostatic mode; for the most part, growth rates are reduced with addition of cold plasma. (auth)

7912 STIMULATION OF vlf AMPLIFICATION IN THE MAGNETOSPHERE. Liemohn, H. B. (Battelle Pacific Northwest Labs., Richland, WA). Space Sci. Rev.; 15: No. 6, 861-889 (May 1974).

Among the various plasma instabilities that exert influence on the dynamic equilibrium state of the magnetosphere, the cyclotron-resonance interaction appears to be the most accessible to artificial stimulation. The strength of the interaction is sensitive to both the background magnetoplasma parameters and the hot energetic particle distribution. Thus, proper modification of one or more conditions can induce significant wave amplification at the expense of hot plasma energy density. Several methods of hot and cold plasma injection were investigated with the linear theory to assess their effectiveness as a means of stimulating amplification. Only the interaction of vlf waves (3 to 30 kHz) with hot electrons (0.1 to 100 keV) is treated here. The injection of a dense jet of barium that travels upward along the geomagnetic

field causes appreciable amplification when the jet is within 30° of the geomagnetic equator. Injection of a geosynchronous lithium cloud stimulates amplification of both vlf and ulf waves, but the magnitude depends critically on the state of geomagnetic activity. Conventional hot electron beams may also amplify narrow frequency bands, but the net wave energy is severely limited by the beam energy. Although the cyclotron-resonance is recognized as a dominant interaction in magnetospheric dynamics, its properties have never been confirmed quantitatively by appropriate spacecraft experiments. Controlled injections would provide important insight into this fundamental process because the induced amplification has a well-defined signature. 60 references. (auth)

7913 FRENCH–SOVIET ARAKS EXPERIMENT. Gendrin, R. (University of California, San Diego, La Jolla). Space Sci. Rev.; 15: No. 6, 905-931(May 1974).

In 1975, a rocket-borne electron-gun experiment will be achieved in Kerguelen Islands (South Indian Ocean). The gun will inject into the magnetosphere large currents (0.5 and 1 A) of high-energy electrons (15 and 27 keV) with different initial pitch angles (~0°, 70, 140°). A nose cone will be ejected at great distance (~10 km) in front of the rocket, equipped mainly with radio-wave receivers, both electric and magnetic, in the frequency range from 0 to 5 MHz, in order to study the wave-particle interactions that will be induced by the beam. Optical and radioelectric observations will be performed in the conjugate area, in the district of Arkhangelsk (U.S.S.R.). During one of the two flights (launched in the magnetic meridian) attention will be focused on the wave-particle interactions that are expected to be stronger when the beam is injected along the magnetic field line. The second flight, which will be launched toward the east, is attempted to study the azimuthal drift of the injected electrons and to derive some conclusions concerning the dc electric field, integrated over the line of force that joins the two conjugate points (L = 3.7). During both flights the energy and pitch-angle distribution of atmospherically backscattered electrons will be studied. The experiment is described and the results are given of some preliminary computations that were made in order to predict the amplitude of the expected phenomena. A discussion is given of the respective ability for electron-beam injection and cold plasma injection to artificially induce strong particle precipitation. 63 references. (auth)

7914 GUIDED PROPAGATION OF VERY LOW FREQUENCY ELECTROMAGNETIC WAVES NEAR THE CONSTANT VELOCITY MODE THROUGH ELECTRON DENSITY IRREGULARITIES. Cernogora, G. (CNRS, Saint-Maur-des-Fosses, France). Ann. Geophys.; 29: No. 1, 1-19(Jan 1973). (In French).

An ionized medium in the presence of a magnetic field is considered, this medium containing an irregularity in the form of an electron density trough aligned with the field. An irregularity of this type can guide electromagnetic waves at very low frequencies, beneath the electron gyrofrequency. The conditions to be fulfilled for the guiding of waves at frequencies of less than half the gyrofrequency having normals highly inclined to the magnetic field and lying in the region of the resonance cone are investigated. The guiding can take place in two ways: the corresponding ray diagrams are plotted. Propagation time calculations indicate that if the wave normals remain highly inclined, then the wave packets propagate along the axis of the irregularity at a constant velocity whatever the width of the irregularity. Studies of the variations in this velocity as a function of the frequency and inclination of the normal at the point where the wave traverses the axis of the irregularity, demonstrate that the most rapid wave is propagated in the constant velocity mode previously defined by Gendrin. (FR)

7915 SOLAR PROTON ENTRY TO THE MAGNETOSPHERE ON 18 NOVEMBER 1968 AND 25 FEBRUARY 1969. II. Comparison of Trajectory Computations in Two Model Magnetospheres. Willis, D. M.; Thomas, G. R.; Pratt, R. J. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 36: No. 6, 1019-1035(Jun 1974).

Solar-proton data recorded over the Earth's polar caps during the initial phases of the November 18, 1968 and February 25, 1969 solar events are analyzed by computing proton trajectories in two different model magnetospheres, and the results obtained using these two models are compared. The first model magnetosphere is developed from the Mead–Williams model and the second from the Hones–Taylor model. No major differences are found between the results obtained for 130-MeV protons if the trajectories are terminated at a distance of 25 Earth radii in the tail. Results obtained with the second model for trajectories extending to a distance of 100 Earth radii in the tail indicate that the entry of solar protons through the geomagnetic tail is independent of the sector structure of the interplanetary magnetic field. (auth)

7916 DAMPING AND NONLINEAR WAVE-PARTICLE INTERACTIONS OF ALFVEN-WAVES IN THE SOLAR WIND. Lee, M. A.; Voelk, H. J. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). (1973). vp.

From 33rd annual meeting of the Deutsche Geophysikalische Gesellschaft and Arbeitsgemeinschaft Extraterrestrische Physik; Goettingen, Ger. (8 Mar 1973).

It is shown that the spectrum of Alfven waves in the solar wind should damp markedly between about $\frac{1}{3}$ A.U. and a few A.U. This implies relatively less modulation of cosmic particles beyond the Earth as compared to calculations using the adiabatic wave propagation. Also, because the interaction is proportional to the frequency and because a cascading of energy occurs for waves of the same polarization, a steepening of the spectrum is expected. This is consistent with observations that indicate a steepening for periods shorter than about an hour. (GE)

7917 SOLAR PROTON ENTRY TO THE MAGNETOSPHERE ON 18 NOVEMBER 1968 AND 25 FEBRUARY 1969. I. Interpretation of Satellite Data Using Trajectory Computations in a Model Magnetosphere. Thomas, G. R.; Willis, D. M.; Pratt, R. J. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 36: No. 6, 993-1017(Jun 1974).

Latitudinal distributions of high-energy (~100 MeV) solar protons measured over the Earth's polar caps by low-altitude polar-orbiting satellites are described. The data, which refer to the initial phases of the 18 November 1968 and 25 February 1969 solar events, are related to interplanetary particle and magnetic-field measurements by means of trajectory computations using a model magnetosphere. A feature of this model magnetosphere, which is based on the Hones–Taylor model, is its realistic representation of the geomagnetic tail under relatively quiet magnetic conditions. It is shown that the proton distributions over the polar caps are consistent with the field-aligned particle anisotropies measured outside the magnetosphere in the initial phase of the two events. Lower-latitude maxima in the proton count rates are associated with particle entry through the dawn side of the magnetopause, and higher-latitude minima are associated with particle entry through the dusk side. Particle entry also occurs through the magnetotail and this mode of access produces enhancements of the proton count rates in the central polar caps. These results imply that solar protons had direct access to the magnetosphere during the two events. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

7918 ATOMIC AND NUCLEAR PHYSICS. Gopala Krishnan, K. Madras; Macmillan Company of India (1973). 564p.

Topics from atomic and nuclear physics generally studied at the graduate and post-graduate levels in the Indian Universities are covered. (MGB)

Beams and Their Reactions

Refer also to abstract 7942.

7919 EMISSION OF INTENSE CURRENTS OF NEGATIVE IONS FROM SURFACES IRRADIATED BY FAST DISCHARGE PARTICLES. Bel'chenko, Yu. I.; Dimov, G. I.; Dudnikov, V. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2573-2577(Dec 1973). (In Russian).

From discharge plasmas with mixtures of hydrogen with cesium, ion currents of H^- with a density up to 3.7 amp/cm^2 are obtained. The intense H^- current is formed because of the secondary negative ion emission with the cold cathode bombarded by fast particles from the discharge. (tr-auth)

7920 GRAPHITE FILAMENT METHOD FOR IMPROVING THE EMISSION EFFICIENCY OF U^+ IONS. Sasaki, N.; Kubo, K.; Asano, M. (Kyoto Univ., Uji, Japan). J. Phys., E (London); 7: No. 5, 386-388(May 1974).

A graphite filament method was used to improve the emission efficiency of U^+ ions in the surface ionization from the single filament source of a mass spectrometer. The graphite filament serves as a raw material for the formation of uranium dicarbide samples and as an ionization surface in place of metallic ones. The intensity of U^+ ions emitted from uranium dicarbide on the graphite filament is much greater than that of UO_2^+ ions from the oxide sample on tungsten, and the emission is very stable for a long period. The reason for this intense and stable emission is discussed. (auth)

7921 HIGH ENERGY POLARISED PROTON BEAMS. Aust. Phys.; 11: No. 2, 26-27(Feb 1974).

An ion source capable of producing polarized proton beams is described. Molecular hydrogen is dissociated into atomic hydrogen by an rf discharge. The atomic hydrogen then enters an extended magnetic field configuration, initially moving down a sextupole magnet, and on emerging enters a transverse magnetic field. In these magnetic fields the spin motion of each atom changes adiabatically. (RL)

7922 TSYTOVICH RADIATIVE CORRECTIONS TO IONISATION LOSS OF HIGH ENERGY ELECTRONS IN NUCLEAR EMULSIONS. Virk, H. S. (Panjabi Univ., Partiala, India). Nucl. Phys.; B72: No. 3, 393-396(1974).

An ionization loss versus velocity curve has been established for relativistic particles in the range $\gamma = 2$ to 70. The ionization loss of electrons with γ values from 100 to 6000 has been investigated. No decrease in ionization loss through radiative corrections according to Tsytovich theory is observed. (auth)

7923 VELOCITY DISTRIBUTIONS IN METASTABLE ATOM BEAMS PRODUCED BY COAXIAL ELECTRON IMPACT. Rundel, R.D.; Dunning, F.B.; Stebbings, R.F. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). Rev. Sci. Instrum. 45: No. 1, 116-119 (Jan 1974).

A technique is described for producing a beam of metastable atoms utilizing coaxial electron impact excitation. Measured velocity distribution functions are presented for metastable helium, neon, and argon. Characteristics of the coaxial source are compared with those of a transverse excitation source. (auth)

7924 LASER-GENERATED PULSED ATOMIC BEAMS. Friichtenicht, J.F. (TRW Systems Group, Redondo Beach, California 90278). Rev. Sci. Instrum. 45: No. 1, 51-56 (Jan 1974).

The irradiation of thin films of solid material by a moderate energy (0.5 J/pulse) Q-switched ruby laser beam has been used to produce intense pulses of neutral atoms and molecules in the 1 to 10 eV energy range. For a given total laser beam energy, both the flux and energy range of atoms within the pulse can be varied within limits by adjusting the energy density of the laser light at the target surface. As observed at a distance of 60 cm from a thin BiF_3 compound target, the flux of 5 eV fluorine atoms from a typical burst was estimated to be about 1.3×10^7 atoms/cm^2/sec. For the same burst, the flux integrated over the 1 to 10 eV range yields a value of $\sim2\times10^{13}$ atom/cm^2. Similar results were obtained with aluminum and uranium thin films. (auth)

7925 INVESTIGATION OF THE PRODUCTION OF NONCHARACTERISTIC X RAYS DURING Ar-Si COLLISIONS AT 270 keV. Cairns, J.A.; Marwick, A.D.; Macek, J.; Briggs, J.S. (Atomic Energy Research Establishment, Harwell, Didcot, Berkshire, United Kingdom). Phys. Rev. Lett. 32: No. 10, 509-512 (11 Mar 1974).

This study elucidates the role played by implanted argon in the production of Ar L, noncharacteristic, and Si K x rays during 270-keV argon bombardment of silicon carbide. (auth)

7926 THE ROLE OF DC SELF-BIAS POTENTIAL IN THE CONTROL OF RF SPUTTERING. Lamont, L.T. Jr.; Turner, F.T. (Varian Associates, Palo Alto, California 94303). J. Vac. Sci. Technol. 11: No. 1, 47-51 (Jan 1974).

For rf, as with dc sputtering, the deposition rate may be uniquely related to the power delivered to the target electrode. The power delivered to the electrode is less than the power delivered by the rf generator by an amount equal to the rf losses in the system. These losses can be substantial and quite variable, even when a good match is indicated at the generator. It is shown that an important source of such losses is seemingly insignificant amounts of series inductance between the matching network and the powered electrode. Deposition rate cannot then, in general, be related reproducibly to the power delivered by the generator. Data are presented which show that, for a given discharge mode, the dc self-bias potential is uniquely related to the power delivered to the electrode and hence to the deposition rate. Implications of this observation as they relate to control of the sputtering process are discussed. (auth)

7927 ANGULAR DEPENDENCE OF STICKING COEFFICIENTS ON TUNGSTEN. Steinbrüchel, C.; Schmidt, L.D. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. Lett. 32: No. 11, 594-596 (18 Mar 1974).

The sticking coefficients s of H_2, D_2, N_2, CO, and CO_2 have been measured as a function of angle of incidence on the (100) and (110) planes of W. s generally increases towards grazing incidence as predicted by a classical model involving energy dissipation by phonon production. However for H_2 and D_2 on W(110), s decreases markedly towards grazing incidence. This suggests the existence of a threshold for energy transfer. (auth)

7928 FORMATION OF A VIRTUAL CATHODE BY A RELATIVISTIC ELECTRON BEAM FLOWING THROUGH A CAVITY. Friedman, M. (Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 24: No. 7, 303-305 (1 Apr 1974).

A region of strong electric field (i.e., a virtual cathode) is formed when a relativistic electron beam is forced to flow through a cavity. This region is located at the entrance of the cavity and significantly affects the behavior of the beam. (auth)

7929 CREATION OF L-SHELL VACANCIES IN TITANIUM AND MANGANESE BY BROMINE-ION BOMBARDMENT. Kast, J.W.; Budick, B.; Rushton, A.M.; Skoski, L.; Verschell, H.J. (Physics Department, New York University, New York, New York 10003). Phys. Rev. Lett. 32: No. 13, 697-700 (1 Apr 1974).

We employed a graphite mosaic crystal spectrometer to study the K x rays from thin targets of titanium and manganese following bromine-ion bombardment. From the shifts and intensity ratio of the K α and Kβ x rays we determine the L- and M-shell vacancies at K x-ray emission. By estimating the effects of vacancy rearrangement before K x-ray emission, we conclude that in the initial collision more L vacancies are created in titanium than in manganese. (auth)

7930 ^{4}He ATOMIC BEAM SCATTERING FROM CLEAN SURFACES OF SILICON AND GERMANIUM. Houston, D.E.; Frankl, D.R. (Department of Physics, The Pennsylvania State University, University Park, Pennsylvania 16802). J. Chem. Phys. 60: No. 8, 3268-3270 (15 Apr 1974).

A modulated, nozzle type ^{4}He atomic beam has been used to investigate scattering from clean, room temperature surfaces of silicon and germanium. The surfaces are prepared by cleaving in situ under ultrahigh vacuum, the pressure being in the low 10^{-9} Torr range. The beam can be operated with the source gas at room temperature or cooled with liquid nitrogen, resulting in a wavelength of $\sim$0.57 and $\sim$1.07 Å, respectively. The scattered beam is subspecularly directed with a maximum intensity less than 1% of the incident beam intensity. (auth)

7931 SECONDARY ELECTRON YIELD WITH PRIMARY ELECTRON BEAM OF KILO-ELECTRON-VOLTS. Shimizu, R. (Department of applied Physics, Osaka University, Suita, Osaka, Japan). J. Appl. Phys. 45: No. 5, 2107-2111 (May 1974).

Secondary electron yields δ_{PE} due to primary electrons of kilo-electron-volts are estimated for various metals by measuring total

electron yields δ_T in an UHV system and using a Monte Carlo calculation to derive δ_{PE} from δ_T. The dependences of δ_T/δ_{PE} as well as δ_{PE} on both the atomic number Z and primary energy are also discussed from a theoretical view point based on the Monte Carlo technique for primary energies higher than a few keV and on a simple theory for lower primary energies. (auth)

7932 RADIAL FLOW OF CONICAL BEAMS OF CHARGED PARTICLES. Bosi, G. (Département de Physique, Université de Moncton, Moncton, New Brunswick, Canada). J. Appl. Phys. 45: No. 4, 1698-1700 (Apr 1974).

The usual geometry of a spherically symmetric radial-flow Pierce-type gun is criticized and some shortcomings are underlined. The general equation defining the family of field forms ensuring third-order radial flow is carried out and a particular solution is selected. The shape of electrodes providing the chosen field form is calculated in a simple and reliable way. (auth)

Atomic and Molecular Properties

Refer also to abstracts 6349, 7963, 7991, 8013, 8015, 8023, 8024, 8033, 8037, 8041, and 8507.

7933 $S_{\frac{1}{2}}-P_{\frac{1}{2}}$ -LAMB SHIFT IN THE n = 5 AND n = 6 STATES OF IONIZED HELIUM. Eibofner, A. (Univ., Tuebingen, Ger.). Phys. Lett.; 47A: No. 5, 399-400(22 Apr 1974).

The $S_{\frac{1}{2}}-P_{\frac{1}{2}}$ -splittings in the n = 5 and n = 6 states of He^+ were determined by an r.f. method to be (905.2 ± 1.0) MHz and (526.7 ± 2.5) MHz, respectively (theory: 906 and 524.2 MHz). The electric fields in the resonance cell and their dependence on the experimental parameters were examined. (auth)

7934 THERMODYNAMIC FUNCTIONS OF MOLECULAR HYDROGEN FROM AB INITIO ENERGY LEVELS. Kosloff, R. (Hebrew Univ., Jerusalen); Levine, R. D.; Bernstein, R. B. Mol. Phys.; 27: No. 4, 981-992(Apr 1974).

A tabulation is presented of the thermodynamic properties of molecular hydrogen (H_2, D_2 and HD), calculated using energy levels which had been obtained via a solution of the Schroedinger equation. The present results should be more accurate than prior computations based on spectroscopic extrapolation formulas. They provide the first example of an accurate determination of a bulk, macroscopic property directly from first principles (input: masses and Coulomb's law). The results are tabulated for ortho, para, the equilibrium and the frozen (or "normal") mixture (3:1 for H_2, 1:2 for D_2) over the temperature range 5 to 300 K and for the frozen mixture up to 6000 K. The importance of anharmonicity and of quasi-bound levels at high temperatures is discussed. (auth)

7935 COULOMB HOLE IN THE 2^3S STATE OF THE HELIUM ISOELECTRONIC SEQUENCE. Boyd, R. J. (Mathematical Inst., Oxford); Katriel, J. Int. J. Quant. Chem.; 8: No. 2, 255-261(Mar 1974).

The pair distribution functions evaluated for the 2^3S state of the helium isoelectronic sequence from the Hart and Herzberg correlated wave functions and those corresponding to the Hartree–Fock approximation are used to determine the shape of the corresponding Coulomb holes. As a consequence of a discontinuity in the Hartree–Fock solution between He and Li^+, the Coulomb hole has a different shape for He than for Li^+ and the other isoelectronic ions. (auth)

7936 DEPENDENCE OF THE INTENSITY OF THE ABSORPTION BANDS OF Eu^{3+} IN SOLUTION UPON THE ANIONS PRESENT. Chrysochoos, J. (Department of Chemistry, The University of Toledo, Toledo, Ohio 43606). J. Chem. Phys. 60: No. 3, 1110-1112 (1 Feb 1974).

The narrow and very weak absorption bands of Eu^{3+} in solution at 526 nm and 579 nm associated with the transitions $^7F_0$–$^5D_1$ and $^7F_0$–$^5D_0$, respectively, are accompanied by red-shifted broad bands. The red shift depends upon the anion present and it is independent of the solvent. In the case of $EuCl_3$ the red shift was found to be 335±2 cm^{-1} whereas in the case of $Eu(NO_3)_3$ a red shift of 366±2 cm^{-1} was observed. The intensity of the broad bands is solvent dependent and it increases as the dielectric constant of the solvent decreases. These bands are attributed to the nonionized rare-earth salts, i.e., >Eu—Cl and/or >Eu–NO_3. On the other hand, the intensity of the narrow band at 526 nm is almost unchanged despite the changes in the intensity of the broad band. Since the intensity of the band at 526 nm, which is associated with Eu^{3+}, ought to decrease as the intensity of the broad band increases, the lack of change may be attributed to an enhancement of the appropriate oscillator strength due to vibronic effects associated with such species as >Eu–Cl and/or >Eu–NO_3. (auth)

7937 MEASUREMENT OF S-P COHERENCE IN THE BEAM-FOIL–EXCITED n = 2 STATE OF ATOMIC HYDROGEN. Gaupp, A.; Andrä, H. J. Macek, J. (Institut für Atom- und Festkörpersphysik, Freie Universitat Berlin, Berlin, Germany). Phys. Rev. Lett. 32: No. 6, 268–271 (11 Feb. 1974).

The intensity of beam-foil-excited Ly-α radiation has been measured in electric fields alternately parallel and antiparallel to the beam. Measurements were made at three energies—100, 165, and 210 keV—and three field strengths. From these data the *S-P* coherence term σ_{SP} has been determined. The magnitude of σ_{SP} is found to be 0.07 at 110 keV, 0.19 at 160 keV, and 0.22 at 210 keV. These results establish that beam-foil–excited hydrogen atoms have a nonzero electric dipole moment. (auth)

7938 FIRST IONIZATION POTENTIALS OF SOME REFRACTORY OXIDE VAPORS. Rauh, E.G.; Ackermann, R.J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 60: No. 4, 1396-1400 (15 Feb 1974).

The ionization potentials of the gaseous atoms, monoxides, and dioxides over the refractory oxides of Ti, Zr, Hf, Th, U, Y, and La have been obtained from ionization efficiency curves and appearance potentials by electron impact. A method of simultaneous and intercomparative measurements with known standards was used. The measured values for the gaseous metal atoms are in agreement with the spectroscopic values except for Zr and Hf which are about 0.4 eV lower. These results and some of previous studies show that the values for the monoxides are somewhat less than those for the metals, and the dioxides of those metals in their highest oxidation state are generally larger by 3–4 eV. (auth)

7939 STUDY OF THE ELECTRONIC STRUCTURE OF MOLECULES. XXII. CORRELATION ENERGY CORRECTIONS AS A FUNCTIONAL OF THE HARTREE-FOCK TYPE DENSITY AND ITS APPLICATION TO THE HOMONUCLEAR DIATOMIC MOLECULES OF THE SECOND ROW ATOMS. Lie, G.C.; Clementi, E. (IBM Research Laboratory, San Jose, California 95193). J. Chem. Phys. 60: No. 4, 1288-1296 (15 Feb 1974).

A semiempirical functional of the Hartree–Fock type density, previously obtained for the Hartree–Fock atomic functions and applied with good success to the second row hydrides (in paper XXI of this series), is now applied to the molecules $H_2(X\ ^1\Sigma^+_g)$, $Li_2(X\ ^1\Sigma^+_g)$, $Be_2(^1\Sigma^+_g)$, $B_2(X\ ^3\Sigma^-_g)$, C_2 $(X^1\Sigma^+_g)$, $N_2(X\ ^1\Sigma^+_g)$, $O_2(X^3\Sigma^-_g)$, and $F_2(X\ ^1\Sigma^+_g)$. For each molecule the potential energy curve is computed from the repulsive region to large internuclear distances. In order to follow the dissociation to the correct limits, we have added to the Hartree–Fock configuration of each molecule those configurations which are needed for describing proper dissociation (HFPD functions). It is found that for certain molecules (Li_2, B_2, C_2, and O_2) there are configurations which contribute quite significantly in the bonding regions and must be added to the HFPD function to reach a proper reference state function as previously defined (see paper XXI). With our functional of the density applied to the HFPD functions, the calculated dissociation energies are, with the experimental values given in parentheses, 4.69 eV (4.75 eV), 0.65 eV (1.14 eV), 1.64 eV (3.0 eV), 3.48 eV (6.36 eV), 9.34 eV (9.91 eV), 3.75 eV (5.21 eV), and 1.37 eV (1.66 eV) for H_2, Li_2, B_2, C_2, N_2, O_2, and F_2, respectively. More realistic dissociation energies are obtained for Li_2 (1.03 eV), B_2 (3.06 eV), C_2 (5.21 eV), and O_2 (4.64 eV) if we use the proper reference state functions. The $^1\Sigma^+_g$ state of Be_2 arising from the ground state atoms is repulsive. The agreement with the experimental dissociation energy is satisfactory but not as good as what we have previously obtained for the second row hydrides. However, owing to the extreme simplicity of the method it appears in a preliminary way that the combination of a Hartree–Fock type function and the functional of its density (of the form that we have proposed) is capable of yielding sufficiently reliable results for very little computational and human effort. Since the parametrization of the density functional was made for the atomic systems and not changed in the molecular formation, our method does not suffer from the need of variation of parameters introduced ad hoc and differing from molecule to molecule. (auth)

7940 EXPERIMENTALLY DETERMINED OSCILLATOR STRENGTHS FOR MOLECULAR HYDROGEN. I. The Lyman and Werner Bands Above 900 A. Fabian, W.; Lewis, B. R. (Univ. of Adelaide). J. Quant. Spectrosc. Radiative Transfer; 14: No. 6, 523-535(Jun 1974).

Photoelectric absorption measurements were performed on molecular hydrogen under conditions where the line profile is dominated by Doppler broadening. A curve of growth analysis was used to relate the measured equivalent width to the line oscillator strength, and the appropriate band oscillator strength was calculated from this using Hönl–London factors. Oscillator strengths for eleven Lyman and six Werner bands obtained in this way show close agreement with those deduced from inelastic electron scattering data. Recent theoretical calculations are in good agreement for the Lyman bands and show only a small systematic discrepancy for the Werner bands. (auth)

7941 EXPERIMENTALLY-DETERMINED OSCILLATOR STRENGTHS FOR MOLECULAR HYDROGEN. II. The Lyman and Werner Bands Below 900 A, the B–X, and the D–X Bands.

Lewis, B. R. (Univ. of Adelaide). J. Quant. Spectrosc. Radiative Transfer; 14: No. 6, 537-546(Jun 1974).

Results are presented of experimental oscillator-strength measurements for four Lyman, one Werner, two $B'-X$ and two $D-X$ bands of molecular hydrogen in the wavelength region between 850 and 900 Å. A photoabsorption technique and equivalent-width analysis similar to that described in the first paper of this series (Fabian et al., J. Quant. Spectrosc. Radiat. Transfer; 14: 523 (1974)) was employed but, in this case, all measurements were taken with the absorbing gas at liquid-air temperature. This procedure resulted in a simplification of the absorption spectrum, making it possible to study lines which were unresolved at room temperature. Excellent agreement with the most recent theory is observed for the Lyman bands, but the experimental Werner band oscillator strength is slightly low, consistent with the trend observed above 900 Å in the previous work. No other experimental results exist for the bands studied, and no theoretical oscillator strengths are available for the $B'-X$ and $D-X$ bands. (auth)

7942 OPTICAL ELECTRIC RESONANCE INVESTIGATION OF A FAST HYDROGEN BEAM. III. Experimental Procedure and Analysis of H(n = 4) Quantum States. Silverman, M. P.; Pipkin, F. M. (Harvard Univ., Cambridge, MA). J. Phys., B (London); 7: No. 6, 747-767(21 Apr 1974).

The apparatus and experimental procedure for optical electric resonance investigation of a fast hydrogen beam are described. Particular attention is paid to the design and performance of the radiofrequency system. The generalized rotating field model of the atom-rf field interaction developed in Part I (J. Phys. B. Atom. Molec. Phys.; 7: 704-729(1974)) and the optical detection function derived in Part II (J. Phys. B. Atom. Molec. Phys.; 7: 730-746(1974)) are employed in conjunction with computer simulation and least squares fitting techniques to extract information on the initial states from experimental optical electric resonance spectra of the H(n = 4) manifold. (auth)

7943 OPTICAL ELECTRIC RESONANCE INVESTIGATION OF A FAST HYDROGEN BEAM. I. Theory of the Atom-RF Field Interaction. Silverman, M. P.; Pipkin, F. M. (Harvard Univ., Cambridge, MA). J. Phys., B (London); 7: No. 6, 704-729(21 Apr 1974).

In a series of articles (the present paper, J. Phys. B. Atom. Molec. Phys.; 7: 730-746 and 747-767(1974)) a novel method is described utilizing optical detection of rf-induced fine structure transitions to investigate the population of excited states of fast hydrogen atoms produced by charge exchange collisions between an initial proton beam and various gas or foil targets. A model of the charge exchange collision and the interaction of the hydrogen beam with an external oscillatory field is considered within the framework of the density matrix formalism. Expressions are obtained also for the rf lineshapes in terms of the initial atomic density matrix elements. (auth)

7944 OPTICAL ELECTRIC RESONANCE INVESTIGATION OF A FAST HYDROGEN BEAM. II. Theory of the Optical Detection Process. Silverman, M. P.; Pipkin, F. M. (Harvard Univ., Cambridge, MA). J. Phys., B (London); 7: No. 6, 730-746 (21 Apr 1974).

The lineshape theory of optically detected rf-induced electric resonance transitions in hydrogen, begun in Part I (J. Phys. B. Atom. Molec. Phys.; 7: 704-729(1974)), is concluded with the treatment of the detection process within the framework of the density matrix formalism. An optical detection function is derived from which can be determined the intensity, polarization, and angular distribution of the detected decay radiation, subject to constraints of apparatus efficiency and geometry, in terms of the initial atomic density matrix elements and variables of the radiofrequency electric field. (auth)

7945 SOLUTIONS OF THE CLASSICAL BOLTZMANN EQUATION FOR He AND Ne GAS BREAKDOWN. Chan, C.H. (Physics Department, University of Alabama in Huntsville, Huntsville, Alabama 35807); Moody, C.D. J. Appl. Phys. 45: No. 3, 1105-1111 (Mar 1974).

A theoretical study of gas breakdown induced by intensive CO_2 laser radiation is given. The basic assumption is that the gas breakdown is due to the process of cascade ionization. The Boltzmann equation for the electron energy distribution function is solved. Details of the numerical method and breakdown thresholds for He and Ne gases are given. The results are in reasonable agreement with the experimental results and are rather sensitive to the gas pressure. (auth)

7946 POLARIZATION OF DEUTERON AND ITS EFFECT ON THE ISOTOPIC SHIFT OF HYDROGEN AND DEUTERIUM LEVELS. Labzovskii, L.N. Opt. Spectrosc. (USSR) 35: No. 5, 574-575 (Nov 1973).

The effect of the polarization of the deuteron on the spectra of the deuterium atom has been determined by an exact calculation using the well model of zero radius for the deuteron. The results indicated that the polarization effect greatly exceeds the usual volume effect, which is due to high polarizability of the deuteron. (AIP)

7947 CALCULATION OF THE BOUNDARIES OF THE ELECTROSTATIC POTENTIAL AT THE NUCLEUS AND OF THE CONSTANTS OF NUCLEAR DIAMAGNETIC SCREENING IN THE GROUND AND FIRST EXCITED STATES OF THE ISOELECTRONIC SEQUENCES OF HELIUM AND LITHIUM. Penkina, N.N.; Rebane, T.K. Opt. Spectrosc. (USSR) 35: No. 5, 461-462 (Nov 1973).

The inequality derived earlier by the authors was used for calculating the upper and lower boundaries of the electrostatic potential, produced by electrons at the nucleus, in various states of atoms and ions of the isoelectronic sequences of helium and lithium. In the calculation only the total nonrelativistic energies were used. They were determined from spectroscopic data with an account for relativistic corrections and reduced electron mass corrections. The results are in good agreement with available electron mass corrections. The results are in good agreement with available precise quantum-mechanical calculations. Simultaneously with the boundaries of the electrostatic potential, the boundaries of the constants for nuclear diamagnetic screening were determined. (auth)

7948 ION–MOLECULE REACTIONS AND VIBRATIONAL DEACTIVATION OF H_2^+ IONS IN MIXTURES OF HYDROGEN AND HELIUM. Theard, L.P.; Huntress, W.T. Jr. (Jet Propulsion Laboratory, Pasadena, California 91103). J. Chem. Phys. 60: No. 7, 2840-2848 (1 Apr 1974).

Ion cyclotron resonance techniques have been used to determine the thermal energy rate constants for the ion–molecule reactions:

$$(H_2^+)^v + H_2 \xrightarrow{k_1} H_3^+ + H,$$

$$(H_2^+)^v + He \xrightarrow{k_2} HeH^+ + H,$$

$$\xrightarrow{k_v} (H_2^+)^{v'} + He$$

$$He^+ + H_2 \xrightarrow{k_3} HeH^+ + H,$$

$$HeH^+ + H_2 \xrightarrow{k_4} H_3^+ + He.$$

For a near-Franck-Condon distribution of initial vibrational states in H_2^+ $k_1 = 2.08 \pm 0.03$, $k_2 = 0.13 \pm 0.01$, $k_3 < 0.002$, and $k_4 = 1.83 \pm 0.06 \times 10^{-9}$ cm³/molecule·sec. Collisional deactivation of vibrationally excited H_2^+ ions is also shown to occur in nonreactive encounters with He atoms. The rate constant k_v for this process increases with increasing vibrational quantum number v and is approximately equal to k_2^v for H_2^+ ions in vibrational state v. (auth)

7949 ENERGY LEVELS AND POTENTIAL ENERGY CURVES FOR H_2, N_2, AND O_2 WITH AN INDEPENDENT PARTICLE MODEL. Miller, K.J. (Department of Chemistry, Rensselaer Polytechnic Institute, Troy, New York 12181); Green, A.E.S. J. Chem. Phys. 60: No. 7, 2617-2626 (1 Apr 1974).

Energy levels for valence and Rydberg states are calculated for H_2, N_2, and O_2. An independent particle model (IPM) with an effective one-electron potential whose nuclear charge is dependent on the electron position is utilized to approximate the Coulomb and exchange interactions. An analytical generalization of the potential parameters to reflect a change in internuclear separation yields accurate average molecular potential energy curves E(R) when experimental ion energies $E^+(R)$ are added to IPM molecular orbital energies ϵ (R), viz., $E(R) = E^+(R) + \epsilon$ (R). A convergence formula for incrementing the energy in the numerical integration procedure is presented. (auth)

7950 ENERGY SPECTRA OF COLLISIONALLY PRODUCED H^- AUTODETACHING STATES. Risley, J.S.; Edwards, A.K.; Geballe, R. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. A 9: No. 3, 1115-1129 (Mar 1974).

Several lines, observed between 9 and 30 eV in the energy spectra of electrons ejected in 100-eV to 10-keV collisions of H^- with He, Ar, and H_2, are attributed to autodetaching states of H^-. The energy of the lowest line associated with the $(2s^2)$ ^1S state of H^- was found to be 9.59 $\pm$ 0.03 eV. Two lines due to Ar^- autodetaching states were used to calibrate the energy scale. The separations in energy between the $(2s^2)$ ^1S line of H^- and several other lines lying below the n = 2 and n = 3 levels of hydrogen were measured. The present results agree well with theoretical predictions and with the experimentally observed resonances in the elastic scattering of electrons on atomic hydrogen. (auth)

7951 MEASUREMENT OF THE PHOTOELECTRIC CROSS SECTION OF H_2 AT 5.4 AND 8.4 keV. Crasemann, B.; Koblas, P.E.; Wang, T.; Birdseye, H.E.; Chen, M.H. (Department of Physics, University of Oregon, Eugene, Oregon 97403). Phys. Rev. A 9: No. 3, 1143-1151 (Mar 1974).

The photoelectric cross section of molecular hydrogen has been measured by counting photoelectrons released by monochromatized x rays traversing highly purified H_2 gas. Results are 54.0 $\pm$ 2.9 mb/atom at 5.41 keV and 12.0 $\pm$ 0.6 mb/atom at 8.39-keV incident-photon

energy. The effect of molecular bonding is pronounced: The measured cross section, per atom, exceeds the theoretical atomic cross section by (44 ± 8) % at 5.41 keV and by (45 ± 7) % at 8.39 keV. A comparable effect has been predicted by Kaplan and Markin. (auth)

7952 COMMENTS ON THE STATE OF AN ELECTRON–HYDROGEN–ATOM SYSTEM IN AN INTENSE ELECTROMAGNETIC FIELD. Fabre, B. (Commissariat à l'Energie Atomique, Centre d'Etudes de Limeil, B.P. N ° 27–94190 Villeneuve St. Georges, France). Phys. Rev. A 9: No. 3, 1450-1451 (Mar 1974).

Some objections concerning the validity of a method which couples two unitary transformations as different as the Reiss and the Henneberger transformations are presented and discussed. In the present state, it seems that only for a weak field or high electron energy can the state of an electron-hydrogen-atom in a field be obtained. (auth)

7953 INFLUENCE OF NUCLEAR SPIN COUPLINGS ON THE THERMOMAGNETIC TORQUE IN HD. Sanctuary, B.C; Beenakker, J.J.M. (Kamerlingh Onnes Laboratorium der Rijksuniversiteit Leiden, Nederland); Coope, J.A.R. J. Chem. Phys. 60: No. 8, 3352-3353 (15 Apr 1974).

Theoretical calculations for the thermomagnetic torque in HD are presented. The energy level diagram for HD including the hyperfine interactions between proton spin of 1/2 and deuteron spin of 1 is calculated. (AIP)

7954 FINE AND HYPERFINE STRUCTURE OF ORTHO-H_2, k(4p) $^3\Pi_u$. Miller, T.A.; Freund, R.S.; Zegarski, B.R. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 60: No. 8, 3195-3202 (15 Apr 1974).

The MOMRIE (microwave optical magnetic resonance induced by electrons) spectrum has been observed and measured for ortho-H_2, k(4p) $^3\Pi_u$, in the lowest four vibrational levels v=0–3, and the lowest rotational level, N=1. The best data are obtained for v=1 and 3; the v=0 data suffer from severe electric field broadening and the v=2 data are affected by a large but undetermined perturbation. Analysis yields values for the spin–orbit and spin–spin coupling constants, the orbital angular momentum and dipolar hyperfine constants, the orbital g factor, and the magnetic and electric susceptibilities. These parameters are then "corrected" for the breakdown of the Born–Oppenheimer approximation by the same procedures previously applied to the d(3p) $^3\Pi_u$ state. The present results are combined with previous work on the np $^3\Pi_u$ Rydberg series [the c(2p) $^3\Pi_u$ and d(3p) $^3\Pi_u$ states of H_2 and the X $^2\Sigma_g^+$ state of H_2^+] to illustrate the variation of fine and hyperfine structure parameters with the principal quantum number, and the deviation of molecular Rydberg states from the united atom model. (auth)

7955 ANALYTICAL HARTREE–FOCK WAVEFUNCTIONS FOR THE NEUTRAL ATOMS FROM HELIUM TO XENON. Roetti, C.; Clementi, E. (IBM Research Laboratory, San Jose, California 95193). J. Chem. Phys. 60: No. 8, 3342-3342 (15 Apr 1974).

Accurate analytical wavefunctions in the Hartree–Fock approximation for the neutral atoms in the ground states are obtained with Slater basis sets from He (Z = 2) to Xe (Z = 54). The total energy is discussed; the wavefunctions (basis sets, expansion coefficients, orbital exponents) are made available elsewhere. (AIP)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

7956 (JU-RR–73-8) CORRECTIONS FOR POSITRON ANNIHILATION IN FLIGHT IN NUCLEAR SPECTROMETRY. Kantele, J.; Valkonen, M. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Mar 1973. 20p. INIS.

Theories of positron single and two-quanta annihilation in flight, the Fermi beta decay theory, and theories of positron energy loss are used in calculations of total probabilities of annihilation in flight of positrons in continuous spectra. The results are given in a nomogram useful in correcting for positron annihilation in flight in various nuclear spectrometry experiments. Confirmation of the theoretical basis employed was obtained by comparing total absolute probabilities for annihilation in flight of ^{62}Cu positrons in Perspex, copper, cadmium and lead, using a new differential method. The agreement with the theory was found to be excellent. A method for obtaining "correct" positron energy spectra with scintillation or semiconductor detectors is proposed. (auth)

7957 (LA-5535-C, pp 247-254) CHEMICAL EFFECTS IN THE CAPTURE OF NEGATIVE MESONS IN MATTER. Knight, J. D. (Los Alamos Scientific Lab., NM). Mar 1974.

From symposium on practical applications of accelerators; Los Alamos, New Mexico (27 Aug 1973).

In proceedings of the symposium on practical applications of accelerators.

An experimental program for the systematic study of chemical effects in negative muon capture is described. The chemical effects considered are those involving the distribution of captures among the individual elements in chemical compounds (Z law effects) and those involving variations in relative intensities of muonic atoms transitions as a function of the chemical environment of the atom. (JFP)

7958 SPUR REACTION MODEL OF POSITRONIUM FORMATION. Mogensen, O.E. (Chemistry Department, Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark). J. Chem. Phys. 60: No. 3, 998-1004 (1 Feb 1974).

A new model of positronium (Ps) formation is proposed. Positronium is assumed to be formed by a reaction between a positron and an electron in the positron spur. Ps formation must compete with electron–ion recombination and electron or positron reactions with solvent molecules and scavenger impurities. It is also influenced by electron and positron solvation. The model correlates the measured Ps formation probabilities with the spur electron properties determined in radiation chemistry. The predictions of the model are shown to be in good agreement with experimental results for liquids and solids. (auth)

7959 MUONIC HEAVY-ATOM SPECTRUM AND NUCLEAR SIZE EFFECT ON VACUUM POLARIZATION. Arafune, J. (The Enrico Fermi Institute, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. Lett. 32: No. 10, 560-562 (11 Mar 1974).

Nuclear finite size correction to the vacuum polarization is examined and applied to muonic atom spectrum. An analytic expression for the potential due to this correction is given. It increases the present discrepancy by 5 eV in the $5g_{9/2}$–to–$4f_{7/2}$ transition in lead. (auth)

7960 ANALYTIC CALCULATION TO ALL ORDERS IN $Z\alpha$ OF NUCLEAR SIZE EFFECTS IN VACUUM POLARIZATION. Brown, L.S.; Cahn, R.N.; McLerran, L.D. (Physics Department, University of Washington, Seattle, Washington 98195). Phys. Rev. Lett. 32: No. 10, 562-565 (11 Mar 1974).

We have calculated the change in the vacuum polarization for muonic atoms with a high-Z nucleus arising from the finite extent of its charge distribution. In the calculation, the electron mass is set equal to zero and only the first term in an expansion in (nuclear radius)/(radius of the muonic state) is retained. The calculation is done to all orders in $Z\alpha$ and a simple closed-form result is obtained. (auth)

7961 EVIDENCE FOR HIGHER SHAPE DEFORMATIONS IN MUONIC X RAYS. Davidson, J.P. (Department of Physics and Astronomy, University of Kansas, Lawrence, Kansas 66045); Close, D.A.; Malanify, J.J. Phys. Rev. Lett. 32: No. 7, 337-339 (18 Feb 1974).

We have fitted the K x rays and hyperfine splittings from muonic ^{232}Th and ^{238}U by a model with a Fermi charge distribution with distortion terms of the type $\beta_{2n}Y_{2n,0}$, $n \leq 3$. We have also reanalyzed for $n \leq 2$ the data for rare-earth deformed muonic atoms. Our results are compared with those of inelastic proton and α scattering as well as Coulomb excitation. Such muonic analyses may provide the preferred determinations of quadrupole moments. (auth)

7962 ATOMIC CAPTURE OF NEGATIVE MESONS. Leon, M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Seki, R. Phys. Rev. Lett. 32: No. 4, 132-135 (28 Jan 1974).

The atomic capture of negative mesons is examined in detail, using the model of Fermi and Teller. We calculate the initial distribution in angular momentum of the mesons upon capture and that after de-exciting through the electron cloud. The mesonic x-ray intensities are computed from a quantum-mechanical cascade and compared with experiment for K^- mesons. Our results agree fairly well with the average (over Z) of the experimental data. (auth)

Collision Phenomena

Refer also to abstracts 6349, 7943, 7945, 7950, 8282, and 8379.

7963 (NP-19980, pp 19-20) ELECTRON–MOLECULE IMPACT IONIZATION. Fletcher, J.; Cowling, I. R. Dec 1972.

7964 (NP-19980, pp 21-23) DIFFERENTIAL CROSS SECTION FOR ELASTIC SCATTERING OF ELECTRONS FROM ATOMIC HYDROGEN. Teubner, P. J. O.; Weigold, E.; Lloyd, C. R.; Lewis, B. R. Dec 1972.

7965 (NP-19980, pp 26) ANGULAR DISTRIBUTION FOR THE ELASTIC SCATTERING OF ELECTRONS FROM ARGON. Teubner, P. J. O.; Weigold, E.; Lloyd, C. R.; Lewis, B. R. Dec 1972.

7966 (ORNL-4954) SMALL-ANGLE SCATTERING IN STRIPPING COLLISIONS OF HYDROGEN ATOMS HAVING ENERGIES OF 1 TO 10 keV IN VARIOUS GASES. Fleischmann, H. H.; Barnett, C. F.; Ray, J. A. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 48p. Dep. NTIS $5.45.

Angular distributions of protons resulting from stripping collisions of neutral hydrogen atoms in the ground state with He, Ar, Kr, H_2, N_2, O_2, H_2O, CO_2, and C_6H_6 were measured for beam energies E between 1 to 10 keV and angles of up to 7 degrees. They are found to be strongly peaked in the forward direction. Where known, total stripping cross sections were used to derive absolute differential cross sections $d\sigma/d\Omega$. For a given gas, the distribution widths vary roughly proportional to 1/E. The product of beam energy and the half cone angle θ_{50} into which 50% of all protons is scattered varies from approximately 0.5 deg·keV for H_2 to approximately 1.7 deg·keV for Kr and C_6H_6. For the atomic target gases, deduced normalized differential cross sections $\rho = \theta s \ln\theta d\sigma/d\Omega$ as functions of $E\theta$ agree in shape roughly with those derived for elastic scattering of hydrogen atoms. The impact parameters corresponding to θ_{50} are estimated. The significance of the peaking in the forward direction is investigated. (auth)

7967 SEMIQUANTAL THEORY OF HEAVY PARTICLE INELASTIC COLLISIONS WITH NEUTRAL ATOMS AND MOLECULES. II. Thermal, Intermediate, and High-Energy Collisions. Flannery, M. R. (Georgia Inst. of Tech., Atlanta). Ann. Phys. (N. Y.); 79: No. 2, 480-517(Aug 1973).

An expression for the internal energy-change suffered by an ion-pair via inelastic binary collisions with a neutral atom or molecule is formulated. On this basis, a semi-quantal theory for neutral–neutral inelastic collisions is developed, and the derived cross sections satisfy the principle of detailed balance. The theory is applied to rotational transitions in molecular hydrogen arising from the resonant transfer at thermal energies of electronic energy of excited atoms and to the ionization of hydrogen and helium atoms by collision with hydrogen atoms at moderate and high energies of impact. (auth)

7968 ELASTIC SCATTERING OF ELECTRONS BY HYDROGEN MOLECULES AT INTERMEDIATE ENERGIES. Truhlar, D. G. (Univ. of Minnesota, Minneapolis); Rice, J. K. Phys. Lett.; 47A: No. 5, 372-374(22 Apr 1974).

Several quantum mechanical calculations of differential cross sections for elastic scattering of electrons by H_2 are compared with the recent experiments by Williams. (auth)

7969 DIFFERENTIAL CROSS SECTIONS FOR THE INNER-SHELL IONIZATION BY RELATIVISTIC ELECTRONS. Das, J. N. (University Coll., Calcutta); Konar, A. N. Nuovo Cim.; 21A: No. 2, 289-296(21 May 1974).

A systematic study of the differential cross section for the inner-shell ionization of a number of atoms for various energies was made. The angular distribution of the scattered electrons, the momentum distribution of the ejected electrons for fixed scattering angles and in all directions are the objects of special attention. (auth)

7970 CHARGE TRANSFER AND FORMATION OF METASTABLE $He^+(2S)$ IONS IN COLLISIONS OF $^3He^{2+}$ IONS WITH POTASSIUM. Shah, M. B.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 5, 637-643(1 Apr 1974).

The formation of $He^+(2S)$ metastable ions by one-electron capture in passage of 10 to 60 keV $^3He^{2+}$ ions through potassium vapor was investigated. Absolute cross sections for $He^+(2S)$ formation, believed to be accurate to within a factor of two, were obtained together with total cross sections for one and two-electron capture. The results were compared with similar measurements in argon which is representative of a number of gas targets previously investigated. The growth of $He^+(2S)$ ions from $^3He^{2+}$ beams as the target thickness of potassium is increased was also investigated. The maximum fractional yield of $He^+(2S)$ ions observed at 30 keV is 1.2%, which compares unfavorably with the yield of 2.5% previously obtained from an H_2 target. (auth)

7971 CHARGE TRANSFER IN He^{2+}–H COLLISIONS IN THE ENERGY RANGE 6 TO 60 keV. Shah, M. B.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 5, 630-636(1 Apr 1974).

Cross sections σ_{11}, for the accidentally resonant charge transfer process $He^{2+} + H(1s) \rightarrow He^+(2s) + H^+$ were determined from studies of the yield of $He^+(2s)$ metastable ions formed in the passage of 6 to 60 keV $^3He^{2+}$ ions through a tungsten tube furnace containing highly dissociated hydrogen. Measured cross sections, believed to be accurate to within a factor of two, exhibit a similar nonresonant energy dependence but are about a factor of four smaller than recent theoretical estimates by Rapp (J. Chem. Phys.; 58: 2043-8 (1973)) based on a multistate impact parameter treatment. Total capture cross sections σ_{21} for the process $He^{2+} + H(1s) \rightarrow He^+(\Sigma(n,l) + H^+$ were also determined and compared with theoretical estimates. The quantity σ_{11}· is found to be between 8 and 10% of σ_{21}. (auth)

7972 ABSOLUTE CROSS SECTIONS FOR THE EXCITATION OF n^1P-LEVELS OF HELIUM BY PROTON IMPACT (150-1000 keV). Hippler, R.; Schartner, K. H. (Giessen Univ., Ger.). J. Phys., B (London); 7: No. 5, 618-625(1 Apr 1974).

Excitation of helium ground state atoms to the 2^1P-, 3^1P-, and 4^1P-levels by proton impact were studied in the energy range of 150 keV to 1000 keV. Total cross sections were obtained by measuring light intensities resulting from the decay of the excited atoms; the corresponding wavelengths lie in the vacuum ultraviolet region. The apparent excitation functions were cascade corrected; polarization corrections have not to be considered due to the special mounting of the monochromator. The cross sections were made absolute by comparing the signal rates resulting from 400 keV proton impact and 1 keV electron impact and using theoretical values for the electron impact cross sections. The results are compared with other experimental and theoretical data. (auth)

7973 ANGULAR DISTRIBUTION OF AUGER ELECTRONS FOLLOWING IMPACT IONIZATION. Cleff, B.; Mehlhorn, W. (Muenster Univ., Ger.). J. Phys., B (London); 7: No. 5, 593-604(1 Apr 1974).

Auger electrons following an ionization by a beam of unpolarized electrons or protons in an inner shell with $j > 1/2$ will have, in principle, a nonisotropic angular distribution depending on the relative population $P(|M|)$ of magnetic substates M of the ionized atom and the Auger transition itself. Formulas for the general case of angular distribution were derived. In the special case of atomic state $J'' = 0$ after the Auger transition, the angular distribution depends only on the relative population $P(|M|)$ of magnetic substates M. For the angular distributions of the $L_3M_{2,3}M_{2,3}$ ($^1S_0$) transition of argon and $M_4N_{4,5}N_{4,5}(^1S_0)$ and $M_5N_{4,5}N_{4,5}(^1S_0)$ transitions of krypton numerical results were derived using electron impact ionization cross sections of magnetic substates calculated by McFarlane (J. Phys. B. Atom. Molec. Phys.; 5: 1906-15 (1972)) and Omidvar (1972). (auth)

7974 ANGULAR DISTRIBUTION OF $L_3M_{2,3}M_{2,3}(^1S_0)$ AUGER ELECTRONS OF ARGON. Cleff, B.; Mehlhorn, W. (Muenster, Univ., Ger.). J. Phys., B (London); 7: No. 5, 506-611(1 Apr 1974).

The angular distribution of $L_3M_{2,3}M_{2,3}(^1S_0)$ Auger electrons of argon was measured by impact ionization with electrons of primary energy E_p = 497 eV, 994 eV and 3976 eV corresponding to the two-, four- and sixteen-fold of the L_3 binding energy of argon. The anisotropy coefficient A_2 of the theoretical angular distribution function $W(\theta) = 1 + A_2P_2(\cos\theta)$ of the $L_3M_{2,3}M_{2,3}(^1S_0)$ Auger electrons of argon was deduced to be 0.05 ± 0.01 for $E_p = 2E(L_3)$ and $4E(L_3)$, and 0.01 ± 0.01 for $E_p = 16E(L_3)$. In the first two cases the Auger electrons are emitted with nonisotropic distribution whereas in the latter case the distribution is isotropic within the experimental error. These results agree well with theoretical results. (auth)

7975 PRINCIPLES AND THEORETICAL INTERPRETATIONS OF THE ELECTRON SCATTERING BY LASER EXCITED ATOMS. Hertel, I. V.; Stoll, W. (Trier-Kaiserslautern Univ., Kaiserslautern, Ger.). J. Phys., B (London); 7: No. 5, 570-582 (1 Apr 1974).

The principles of the measurement of electron differential scattering cross sections of excited atoms are outlined. The target atoms are excited by a dye-laser beam, which is tuned to the fluorescence frequency. The excitation probability for the excited hyperfine level is calculated, and a theoretical interpretation of measured de-excitation cross sections is given. Information not only on the magnitudes but also on the relative phases of the scattering amplitudes may be obtained by the experiment. (auth)

7976 MULTISTATE MOLECULAR TREATMENT OF THE H^+–H COLLISIONS. Chidichimo-Frank, M. C. (Ciudad Univ., Buenos Aires); Piacentini, R. D. J. Phys., B (London); 7: No. 5, 548-557(1 Apr 1974).

The low energy direct and charge exchange, elastic and inelastic proton-hydrogen collisions were studied in an impact parameter eikonal approximation, employing a molecular expansion on the $1s\sigma_g$, $2p\sigma_u$, $2p\pi_u$, $3p\sigma_u$, and $3p\pi_u$ states of the H_2^+ molecule. Results for the 1s, 2s, $2p_0$, $2p_{\pm1}$ and $n \leq 3$ states are presented and compared with other theoretical and experimental values. The influence on the final results of the relevant coupling matrix element between the $2p\sigma_u$ and $2p\pi_u$ is analyzed. (auth)

7977 OPTICAL MODEL WAVE FUNCTIONS FOR ATOMIC SCATTERING. Furness, J. B.; McCarthy, I. E. (Flinders Univ. of South Australia, Bedford Park). J. Phys., B (London); 7: No. 5, 541-547(1 Apr 1974).

The absolute magnitudes and phases of the optical model wave functions for 200 and 400 eV electron elastic scattering on argon are plotted in order to show how the waves are distorted by the potential. The physical understanding so obtained enables an analytic eikonal approximation for the wave function to be developed and verified for use in the calculation of inelastic reactions. This approximation has already proved valid for (e,2e) reactions at 400 eV on argon. (auth)

7978 PROBABILITIES OF TRANSITIONS BETWEEN DEGENERATED ATOMIC MAGNETIC SUBLEVELS INDUCED BY COLLISIONS. Petrashen, A. G.; Rebane, V. N.; Rebane, T. K. Vestn. Leningrad. Univ., Fiz., Khim.; No. 22, 25-31(1973). (In Russian).

The transition probabilities between degenerated Zeeman's sublevels induced by isotropic atomic collisions were considered. In the impact parameter approximation the transition probabilities for $j = 1, 2, ½$ are calculated. The results obtained are compared with the experimental data. Some regularities and inequalities for transition probabilities are discussed. (auth)

7979 ASSOCIATIVE IONIZATION IN U+O AND U+O_2 COLLISIONS. Fite, W.L.; Lo, H.H.; Irving, P. (Extranuclear Laboratories, Incorporated, Pittsburgh, Pennsylvania 15238). J. Chem. Phys. 60: No. 4, 1236-1250 (15 Feb 1974).

Collisions between thermal energy uranium atoms and oxygen atoms and molecules have been studied in four experiments. A triple crossed beam experiment has determined that the ratio of effective cross sections for the associative ionization processes $U+O \rightarrow UO^+ + e$ and $U+O_2 \rightarrow UO_2^+ + e$ is 97 ± 20. An experiment measuring the number of ions formed per unit length by uranium atoms passing through O_2 has determined that the absolute cross section for $U+O_2 \rightarrow UO_2^+ + e$ is $1.68 \pm 0.27 \times 10^{-17}$ cm^2. A total attenuation experiment indicates that the total reaction cross section between U and O_2 is $1.78 \pm 0.45 \times 10^{-15}$ cm^2, implying that over 99% of the reactions lead to the neutral products UO+O while less then 1% give associative ionization. A modulated beam mass spectrometry experiment, employing phase spectrometry, indicates that the activation energy for $U+O_2 \rightarrow UO_2^+ + e$ is extremely small if existent at all. Two Appendices treat the relations between effective cross sections as measured in various experiments to true cross sections as derived from theory and the generation of phase shifts in modulated beam experiments where a beam is detected by reactions with a Maxwellian gas. (auth)

7980 MOLECULAR COLLISIONS. XXI. SEMICLASSICAL APPROXIMATION TO ATOM-SYMMETRIC TOP ROTATIONAL EXCITATION. Russell, D.; Curtiss, C.F. (Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 60: No. 4, 1313-1317 (15 Feb 1974).

In Paper XIX of this series a distorted wave approximation to the T matrix for atom–symmetric top scattering was developed which is correct to first order in the part of the interaction potential responsible for transitions in the component of rotational angular momentum along the symmetry axis of the top. A semiclassical expression for this T matrix is derived by assuming large values of orbital and rotational angular momentum quantum numbers. (auth)

7981 IN-OUT DECOMPOSITION FOR INELASTIC COLLISIONS AS SUBDYNAMICS. II. SCATTERING MATRIX AND APPROXIMATION METHODS. Shipsey, E.J. (Department of Physics, University of Texas at Austin, Austin, Texas 78712). J. Chem. Phys. 60: No. 4, 1589-1592 (15 Feb 1974).

The work of a previous paper is extended. The scattering matrix is expressed in an explicitly unitary form by means of the subdynamics relations. A procedure is given such that a wide variety of approximations can yield a unitary scattering matrix. (auth)

7982 MOLECULAR BEAM AND TRAJECTORY STUDIES OF REACTIONS OF H^+ WITH H_2. Krenos, J.R.; Preston, R.K.; Wolfgang, R. (Department of Chemistry, Yale University, New Haven, Connecticut 06520); Tully, J.C. J. Chem. Phys. 60: No. 4, 1634-1659 (15 Feb 1974).

We have employed two complementary techniques, molecular beam experiments and "trajectory surface hopping" theory, to investigate proton–hydrogen molecule scattering at relative energies between 1 and 7 eV. Absolute cross sections, product translational energy distributions, and product velocity contour diagrams have been obtained from both theory and experiment for the $H^+ + D_2$ and $D^+ + HD$ isotope arrangements. Agreement is excellent, particularly for a theory which involves no empirical information and no adjustable parameters. By combining results from experiment and theory we have been able to develop a fairly complete, reliable, and simple picture of the dynamics of this elementary collision process. For relative energies below about 3 eV the reaction involves a short-lived collision intermediate, whereas above 4 eV it proceeds by a predominantly direct, impulsive mechanism. Above 5.5 eV momentum transfer is well represented by a hard-sphere collision model involving only short-range repulsive forces. The avoided intersection of the two lowest singlet potential energy surfaces of H_3^+ is of primary importance in determining the partitioning of energy among products, the likelihood of electronic transitions, the angular and velocity distributions of products, and the competition among various rearrangement, charge transfer, and fragmentation channels. (auth)

7983 DISSOCIATIVE EXCITATION OF CO BY ELECTRON IMPACT: TRANSLATIONAL SPECTROSCOPY OF LONG-LIVED HIGH-RYDBERG FRAGMENT ATOMS. Smyth, K.C.; Schiavone, J.A.; Freund, R.S. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 60: No. 4, 1358-1367 (15 Feb 1974).

Carbon and oxygen atoms in long-lived high-Rydberg states have been produced by the electron impact dissociative excitation of CO. The observed time-of-flight distributions and excitation functions reveal seven dissociation processes; appearance potentials and dissociation limits have been determined for each of them. For the slowest high-Rydberg fragments the excitation function exhibits sharp, resonancelike structure near threshold. These data are analyzed by the core-ion model of high-Rydberg dissociation, in which the Rydberg electron acts as a spectator to the dissociation process. The observed dissociation limits involve high-Rydberg atomic fragments with ground state ion cores. Available data on the dissociative states of CO^+ and CO^{++} and on the kinetic energy distributions for C^+ and O^+ measured by dissociative ionization experiments are discussed and compared to the high-Rydberg results. (auth)

7984 ENERGETICS OF CHARGED TRANSFER IN COLLISIONS OF Ar^+ IONS WITH H_2, D_2, AND CO_2. Rayborn, G.H. ; Bailey, T.L. (Departments of Physics and Electrical Engineering, University of Florida, Gainesville, Florida 32601). J. Chem. Phys. 60: No. 3, 813-823 (1 Feb 1974).

The energetics of charge transfer in collisions of low-energy Ar^+ ions with H_2, D_2, and CO_2 molecules have been investigated in ion beam–gas scattering experiments, which utilize a special feature of collision kinematics. The kinetic energy (KE) distributions of product ions which emerge from their collision sites at 90° with respect to the projectile beam direction were determined by electrostatic analysis, using a parallel-plate analyzer. At this angle, exothermic transfer channels dominate the observed distributions, and the coupling between projectile and product ion kinetic energies is minimized. Information concerning the contributing transfer channels, and therefore concerning the internal states of the product H_2^+, D_2^+, and CO_2^+ ions, has been deduced from the measured KE distributions. For the Ar^+–H_2, D_2 systems, measurements were carried out at a number of projectile ion KE's, over the range $20 < E_l < 150$ eV. For the Ar^+–CO_2 system, runs were made at $E_l \simeq 6$ eV and $E_l = 20.1$ eV. In addition, a single distribution for the Ne^+–CO_2 system was obtained, at $E_l = 50.1$ eV. The distributions for Ar^+–D_2 and Ar^+–H_2 at the lower collision energies revealed a surprising isotope effect, in that the former showed contributions of fairly energetic ions, whereas the latter consisted solely of ions with near-thermal energies. The Ar^+–CO_2 data at $E_l = 6$ eV gave evidence of CO_2^+ ions with energies $0 \leq E_3 \leq \sim 1$ eV, from which it was inferred that transfer proceeds via a number of exothermic transfer channels, having internal energy changes Q over the entire accessible range $0 < Q \leq 2.16$ eV. The effect of the thermal motions of the target particles (Doppler broadening) has been discussed in some detail. This effect is particularly important in these studies, since the kinetic energies of the product ions were small (for the most part, less than a few tenths of an electron volt). (auth)

7985 THEORETICAL STUDIES IN PHOTOELECTRON SPECTROSCOPY: USE OF ANGULAR DISTRIBUTION DATA TO DEDUCE MOLECULAR ORBITAL PARAMETERS. Ritchie, B. (Chemistry Department, University of Alabama, University, Alabama 35486). J. Chem. Phys. 60: No. 3, 898-907 (1 Feb 1974).

We present formulas for the differential cross section for ejection of energetic molecular photoelectrons. The cross section has been factorized into a radial and angular part. The angular part has been evaluated by use of standard angular momentum algebra, while the radial part requires explicit expressions for each partial wave component of the initial molecular orbital (which must be in the form of a single-center partial wave expansion) and for each partial wave of the photoelectron. We assume a parametrized form for the initial molecular orbital, and we calculate the photoelectron wavefunction by consecutive use of the distorted-wave-Born and Coulomb-Born approximations. This is a perturbative form, valid to $O(k^{-2})$ in the asymptotic region of the wavefunction, where in atomic units k is the velocity of the photoelectron. The theory provides the means to invert angular distribution data, if available, to determine the parameters of the initial molecular orbital. Or, if this orbital is known, the theory provides an accurate high energy limit to test low energy theories or to normalize relative cross section measurements. We calculate the cross section for photoionization of H^+_2 from states of different symmetries as a function of internuclear distance. We indicate how the method can be extended to more complicated molecules. (auth)

7986 CALCULATION OF HIGH ENERGY ELASTIC ELECTRON-MOLECULE SCATTERING CROSS SECTIONS WITH CNDO WAVEFUNCTIONS. Szabo, A. (Department of Chemistry, Harvard University, Cambridge, Massachussetts 02138); Ostlund, N.S. J. Chem. Phys. 60: No. 3, 946-950 (1 Feb 1974).

Differential cross sections for the elastic scattering of electrons from H_2 are calculated within the Born approximation using molecular wavefunctions of different sophistication to determine the sensitivity of the cross sections to the quality of the wavefunction. An approximation to the molecular form factors based on the use of CNDO wavefunctions, which incorporates the distortion of the charge density upon the formation of the molecule without the necessity of calculating two center integrals, is used to calculate differential cross sections for electron scattering from CO, N_2, NH_3, H_2O, and CH_4 as a function of momentum transfer. For CO and N_2 the CNDO calculations are in good agreement with results obtained using ab initio minimal basis wavefunctions and evaluating all integrals. The CNDO calculation describes the recently measured cross sections for NH_3 much better than the method based on the independent atom approximation. (auth)

7987 ATTACHMENT OF SLOW (<1 eV) ELECTRONS TO O_2 IN VERY HIGH PRESSURES OF NITROGEN, ETHYLENE, AND ETHANE. Goans, R.E.; Christophorou, L.G. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). J. Chem. Phys. 60: No. 3, 1036-1045 (1 Feb 1974).

The results of a recent study on the capture of slow (<1 eV) electrons by O_2 embedded in very high pressures of nitrogen (up to 27500 torr), ethylene (up to 17000 torr), and ethane (up to 17500 torr) are presented and discussed. Large changes have been observed in both the magnitude and the energy dependence of the attachment rate (and cross section) with increasing density of these three media. At sufficiently low pressures ($\lesssim$1500 torr for N_2; $\lesssim$2500 torr for C_2H_4; $\lesssim$ 3500 torr for C_2H_6), low-energy electron attachment to O_2 can be treated approximately as a three-body process. However, as the density of each medium increases, each affects the capture process differently, demonstrating the profound effect and importance of the environment on the electron attachment process. Electron capture mechanisms and reaction schemes consistent with the observed dependences of the attachment rates on the density of each medium are presented and discussed. The high-pressure data on O_2 in C_2H_4 and N_2 have been successfully related to "liquid-state" behavior. From the O_2, C_2H_4 data an autoionization lifetime equal to $\sim 2 \times 10^{-12}$ sec has been estimated for O_2^-. (auth)

7988 COMPARISON OF THE THERMAL ENERGY STRUCTURES IN He 2^3S–Ar AND He 2^3S–Ne SECOND KIND COLLISION RATES. Arrathoon, R. (Clarendon Laboratory, Parks Road, Oxford, England). J. Chem. Phys. 60: No. 3, 1187-1188 (1 Feb 1974).

The temperature dependence of the reactions $He2^3S + Ar \rightarrow He + Ar^+ + e$ and He 2^3S + Ne → He + Ne^+ are compared in the region 160–360°K. The He 2^3S–Ar reaction is approximately described in terms of a hard sphere collision model. Hard sphere or Lennard-Jones models do not appear to provide realistic descriptions of the He 2^3S–Ne reaction. (AIP)

7989 VIBRATION-TO-VIBRATION ENERGY TRANSFER IN NEAR-RESONANT COLLISIONS. Shin, H.K. (Department of Chemistry, University of Nevada, Reno, Nevada 89507). J. Chem. Phys. 60: No. 3, 1064-1070 (1 Feb 1974).

An analytic approach is presented for the calculation of vibration-to-vibration (VV) energy transfer in near-resonant systems and is applied to several collision systems over the temperature range of 300–4000°K with particular emphasis on N_2+CO collisions. Calculated values of VV probabilities for CO+N_2 and CO+NO are in good agreement with experimental data. For CO+O_2 and CO+D_2, calculated probabilities are larger than high temperature experimental data by factors of 3 to 5. For all systems, including NO+N_2, the calculated result at low temperatures ($\simeq$300°K) is in reasonable agreement with experiment. It is also shown that the VV probability for CO+N_2 is very large compared with the VT probability for $N_2(v=1)+CO \rightarrow N_2(v=0)+CO$ at lower temperatures. (auth)

7990 METASTABLE HELIUM ATOM FORMATION IN FAST He^{2+} + H_2 COLLISIONS. Gilbody, H. B.; Dunn, K. F.; Gilmore, B. J. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 6, L187-L190(21 Apr 1974).

A beam attenuation technique developed previously was used to study the formation of fast helium metastable atoms formed by two-electron capture neutralization of 400 keV He^{2+} ions in passage through both thin and thick targets of hydrogen. It is shown that the process: $He^{2+} + H_2 \rightarrow He(2^1S) + H^+ + H^+$ has a cross section of 4×10^{-18} cm^2 and accounts for about 76% of all collisions involving two-electron capture. This cross section is about the same as that for metastable atom formation in one-electron capture by He^+ ions of the same energy. (auth)

7991 SHAPE OF THE $(2s^2)^1S$ RESONANCE IN THE SPECTRA OF ELECTRONS EJECTED FROM He ATOMS DURING THEIR ENCOUNTERS WITH FAST ELECTRONS AND PROTONS. Lipovetskii, S. S.; Senashenko, V. S. (Moscow State Univ.). J. Phys., B (London); 7: No. 6, 693-703(21 Apr 1974).

Some aspects of the theoretical description of the intensity and shape of resonances observed in the spectra of electrons ejected from atoms by fast electrons and protons are discussed. Numerical calculations were performed for the $(2s^2)^1S$ resonance of helium atoms. Dependences of the resonance intensity and shape on the collision kinematics, i.e., incident-particle energy and electron ejection angle, were obtained. The considerable variations revealed in the character of the resonance asymmetry with varying ejection angle are associated with a strong interference between separate components of the transition amplitude. (auth)

7992 MEAN ENERGY EXPENDED PER ION PAIR FORMED IN NEON BY ELECTRONS OF LOW ENERGIES. Dayashankar. (Bhabha Atomic Research Centre, Bombay). Physica; 72: No. 1, 206-214(15 Feb 1974).

The mean energy expended per ion pair formed (w) in neon gas of uniform density was calculated for electron-impact energies from 50 eV to 1 keV. The effect of secondary and tertiary electrons was considered by using semiempirical expressions for the energy spectrum of secondary electrons, which were obtained by suitably modifying the expressions of Khare for atmospheric gases. The calculations reveal a fairly strong energy dependence of the value of w for low impact energies. The value decreases from 79 eV for 50 eV electrons to 43.5 eV for 250 eV electrons beyond which it remains constant. This constant value is about 20% higher than the experimental value. (auth)

7993 EXACT SOLUTION TO THE PROBLEM OF A SINGLE-QUANTIZED FIELD MODE INTERACTING WITH A CERTAIN MULTILEVEL ATOMIC SYSTEM. Swain, S. (Queen's Univ., Belfast). J. Phys., A (London); 7: No. 4, L52-L55(1 Mar 1974).

Exact solutions are given to the eigenvalue problem of a single, quantized field mode interacting in the dipole approximation with a single atom which has N-1 levels of one parity and one level of the opposite parity. (auth)

7994 ELASTIC SCATTERING OF ELECTRONS WITH HYDROGEN ATOMS USING THE POLARIZED GLAUBER APPROXIMATION. Mathur, K.C. (Department of Applied Mathematics and Theoretical Physics, The Queen's University of Belfast, Northern Ireland). Phys. Rev. A 9: No. 3, 1220-1224 (Mar 1974).

The Glauber theory for electron–atom collisions is extended to include the polarization effects. The results for the differential and the total elastic-scattering cross sections are presented, and it is observed that the agreement with the available data is improved with the inclusion of such effects. (auth)

7995 EXCITATION CROSS SECTIONS OF BANDS OF THE FIRST NEGATIVE SYSTEM OF NITROGEN IN ELECTRON-ION COLLISIONS. Dashchenko, A.I.; Zapesochnyi, I.P.; Imre, A.I. Opt. Spectrosc. (USSR) 35: No. 5, 562-563 (Nov 1973).

The excitation functions of three of the most intense bands (0,0), (0,1) and (0,2) of the first negative system of molecular nitrogen ion, N_2^+, (electronic transition $B^2\Sigma_u^+ \rightarrow X^2\Sigma_g^+$) have been investigated. Excitation cross sections of the three bands were used to estimate the cross section of the upper vibrational level $v'=0$ of the $B^2\Sigma_u^+$ state. (AIP)

7996 CAPTURE OF ARGON K-SHELL ELECTRONS BY 2.5- TO 12-MeV PROTONS. Macdonald, J.R.; Cocke, C.L. (Physics Department and Nuclear Science Laboratory, Kansas State University, Manhattan, Kansas 66506); Eidson, W.W. Phys. Rev. Lett. 32: No. 12, 648-651 (25 Mar 1974).

Using coincidence techniques, we have measured the cross section for capture of electrons from the K shell of argon atoms by protons in the energy range from 2.5 to 12 MeV. Of the total cross section for electron capture, the contribution of capture from the argon K shell increases with proton energy from 0.5% at 2.5 MeV to 47% at 12 MeV. The contribution of electron capture to the total argon K-shell ionization cross section decreases from 0.4% at 2.5 MeV to less than 0.1% at 12 MeV. (auth)

7997 QUANTUM CORRECTION FACTORS FOR CLASSICAL SMALL ANGLE SCATTERING BY INVERSE POWER POTENTIALS. Anderson, R.W. (Division of Natural Sciences, University of California, Santa Cruz, California 95064). J. Chem. Phys. 60: No. 7, 2680-2683 (1 Apr 1974).

An integral expression is derived for a quantum correction factor that gives the semiclassical differential elastic scattering cross section as a multiple of the Kennard small angle classical scattering cross section. The correction factor is evaluated numerically using the Landau–Lifshitz approximation for inverse power potentials with s=4, 5, 6, and 8. The quantum correction is compared at very small angles with existing semiclassical small angle formulas. The relevance of this theory to the small angle elastic scattering found in reactive systems where the reaction cross section is determined by the collisions which surmount the centrifugal barrier is considered. (auth)

7998 ARGON CHARGE STATES DUE TO IMPACT OF H^+ AND He^+ IONS. Oona, H. (Department of Physics, University of Arizona, Tucson, Arizona 85721). Phys. Rev. Lett. 32: No. 11, 571-574 (18 Mar 1974).

Charge states of argon produced by bombardment with 100-keV to 1-MeV H^+ and He^+ projectiles were studied by examining high-resolution L x-ray satellite spectra. Large differences appear in charge-state populations determined from x-ray data and Auger-electron data. (auth)

7999 OBSERVATION OF MOMENTUM TRANSFER IN ROTATIONALLY INELASTIC MOLECULAR COLLISIONS OF CO_2 WITH H_2, He, CO_2, AND Kr. Meyer, T.W. (University of California, Department of Applied Science, Davis-Livermore, California 94550); Rhodes, C.K. Phys. Rev. Lett. 32: No. 12, 637-640 (25 Mar 1974).

We present an experimental technique enabling a direct observation of the momentum transfer distribution generated by rotationally inelastic molecular collisions of CO_2 with H_2, He, CO_2, and Kr. The observations indicate that the rotational transition results primarily from peripheral collisions which are effective in transferring angular momentum, but which communicate a relatively small linear momentum transfer. The mean change in the z component of velocity is presented for CO_2-H_2 collisions. (auth)

8000 REPLY TO "COMMENT ON MOLECULAR BEAM KINETICS: $D+ClF_3$," BY HELLMUT HABERLAND AND KONRAD SCHMIDT. Cross, J.B. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Chem. Phys. 60: No. 5, 2198-2198 (1 Mar 1974).

The angular distribution of DF from the reaction $D+ClF_3$ is discussed. Any discrepancies in a previous measurement by the author are attributed to the difficulties encountered in detecting extremely small signals near high intensity beams. (AIP)

8001 COMMENT ON "MOLECULAR BEAM KINETICS: $D+ClF_3$" BY JON B. CROSS. Haberland, H.; Schmidt, K. (Fakultät für Physik der Universität Freiburg/Br., Germany). J. Chem. Phys. 60: No. 5, 2197-2197 (1 Mar 1974).

The angular distribution of DF from $D+ClF_3$ was measured by crossing a 2700°K deuterium atom beam with an effusive molecular beam. There was no strong rise in the angular distribution near 90° as reported by J.B. Cross J. Chem. Phys. 59, 966 (1973). (AIP)

8002 CLASSICAL TRAJECTORY STUDIES OF ANGULAR DISTRIBUTIONS OF REACTIONS OF DEUTERIUM ATOMS WITH IODINE MOLECULES. McDonald, J.D. (Department of Chemistry, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 60: No. 5, 2040-2046 (1 Mar 1974).

A three-dimensional classical trajectory study is used to determine the effect of variation of the angular properties of LEPS-type potential energy hypersurfaces on the angular distribution of products of the reaction $D+I_2 \rightarrow DI+I$ for a variety of initial translational and rotational energies. The fraction of the total available energy left in product translation is between 0.18 and 0.30 for various initial conditions. Three potential energy hypersurfaces that vary only in the position of an angle-dependent activation energy give product angular distributions that range from strongly backward to strongly sideways peaked. A very strong correlation is found between the angular properties of the surface and the product angular distribution. Requirements for surfaces needed to match the experimental angular distribution of products of reactions of D plus other halogens are also discussed. (auth)

8003 ANGULAR DISTRIBUTIONS OF PENNING IONS IN CROSSED BEAMS. I. $He(2^1S)+Ar \rightarrow He+Ar^+ + e^-$. Leu, M.T.; Siska, P.E. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). J. Chem. Phys. 60: No. 5, 2179-2180 (1 Mar 1974).

Crossed molecular beam studies of reaction product angular distributions involving electronically excited He and ground state Ar are reported. Penning ionization dynamics of the system is studied. (AIP)

8004 CROSSED BEAM STUDY OF THE REACTION $O^+ + N_2 \rightarrow NO^+ + N$. Smith, G.P.K.; Cross, R.J. Jr. (Department of Chemistry, Yale University, New Haven, Connecticut 06520). J. Chem. Phys. 60: No. 5, 2125-2131 (1 Mar 1974).

The kinematics of the reaction $O^+(^4S)+N_2 \rightarrow NO^+ + N$ were studied using crossed molecular beams. Product angular and energy distributions were measured for the initial relative translational energy range of 1.5-15.8 eV. The products are formed in their ground electronic states. The product distributions are described, with some deviations, by the spectator stripping model. No evidence was found for a persistent complex or for a second mechanism. A scattering chamber study at 0° lab was made of the related reactions $^{15}N^+ + {}^{14}NO \rightarrow {}^{15}N^{14}N^+, {}^{15}NO^+, {}^{14}NO^+$. Our results are discussed in terms of possible surface hopping effects. (auth)

8005 EFFECT OF VIBRATION-ROTATION INTERACTIONS OF VIBRATIONAL RELAXATION IN CO_2. Andreev, E.A.; Kalenov, Y.A.; Umanskii, S.Y. (Institute of Chemical Physics, Academy of Sciences of the USSR). High Temp. 11: No. 2, 245-251 (Nov 1973).

A new mechanism is proposed for the intramolecular $\nu_3 \rightarrow \nu_1, \nu_2$ exchange during collisions of CO_2 with rare-gas atoms and with CO_2 molecules. This mechanism is based on the coupling between the asymmetric and bent vibrations by the Coriolis interaction and its variation during the collisions. This reaction is basic in radiationless quenching of the upper laser level. Satisfactory agreement is obtained with experimental results. (auth)

8006 USE OF CONSISTENT PHASE CONVENTIONS IN CALCULATING ANGULAR DISTRIBUTIONS OF SCATTERING CROSS SECTIONS AND APPLICATION TO ELECTRON-HYDROGEN-ATOM INELASTIC SCATTERING. Brandt, M.A.; Truhlar, D.G. (Chemical Physics Program, Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. A 9: No. 3, 1188-1194 (Mar 1974).

The practical problem of consistent use of a phase convention in calculating differential cross sections from scattering or reactance matrices is discussed, and in two instances (electron-hydrogen-atom and positron-hydrogen-atom scattering) where an inconsistency has been found, we correct some previously published differential-cross-section formulas. We present the first correct calculations of close-coupling approximation differential cross sections for the 1s-2p electron-hydrogen-atom scattering process. We compare the differential cross sections from the 3-state and the 6-state close-coupling-approximation scattering matrices of Burke and co-workers. (auth)

8007 IMPULSE APPROXIMATION FOR THREE-DIMENSIONAL INELASTIC ATOM-DIATOMIC-MOLECULE COLLISIONS. Bogan, A. Jr. (Research Department, Grumman Aerospace Corporation, Bethpage, New York 11714). Phys. Rev. A 9: No. 3, 1230-1241 (Mar 1974).

The impulse approximation of Chew is applied to the calculation of the cross sections for rotational and vibrational excitation of diatomic molecules by collisions with an atom. The assumptions underlying the impulse approximation are discussed and found to be justified for these processes. A closure approximation is used to perform the sums over rotational quantum numbers in the expression for the vibrational-excitation cross section and the resulting expression depends on two factors; an oscillator form factor and the scattering amplitudes for atom-atom scattering. Vibrational-transition probabilities, evaluated for oxygen-carbon monoxide collisions assuming that the oscillator is harmonic and using a rough estimate for the typical atom-atom scattering amplitudes, are in qualitative agreement with experiment. Further refinements and extensions of the model are discussed. (auth)

8008 SEMICLASSICAL COLLISION THEORY WITHIN THE FEYNMAN PATH-INTEGRAL FORMALISM. II. APPLICATION TO VIBRATIONAL EXCITATION. Penner, A.P.; Wallace, R. (Department of Chemistry, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2). Phys. Rev. A 9: No. 3, 1136-1142 (Mar 1974).

A multichannel semiclassical collision theory, based on Feynman's path-integral formulation of quantum mechanics and discussed previously by us, is applied to the problem of vibrational excitation during collinear atom-diatom collisions. The diatom is treated as a hamonic oscillator and the atom-diatom interaction is an exponential repulsion. The semiclassical results are compared with the exact quantum-mechanical calculation of Secrest and Johnson and with the classical S-matrix theory of Miller and Marcus. It is found that the present theory is not as generally useful as the theory of Miller and Marcus. (auth)

8009 OBSERVATION OF K X RAYS FROM HIGHLY IONIZED STATES OF NEON PRODUCED BY 40-MeV Cl^{+7}, Cl^{+11}, AND Cl^{+13} BEAMS. Brown, M.D.; Macdonald, J.R.; Richard, P. (Department of Physics and Nuclear Science Laboratory, Kansas State University, Manhattan, Kansas 66506); Mowat, J.R.; Sellin, I.A. Phys. Rev. A 9: No. 3, 1470-1474 (Mar 1974).

The K x-ray transitions of neon produced in single collisions of 40-MeV Cl^{+7}, Cl^{+11}, and Cl^{+13} beams with neon targets are resolved into eight components. Over half the x-ray production is found to be associated with the two- and three-electron system in all cases. Strongly charge-dependent neon Ly-α production is also observed. X-ray and vacancy-production cross sections are obtained for each component separately. We show that the vacancy-production cross section rather than the change in fluorescence yield dominates the charge dependence of the x-ray yields. (auth)

8010 ELASTIC SCATTERING OF ELECTRONS FROM N_2. Sawada, T.; Ganas, P.S.; Green, A.E.S. (University of Florida, Florida 32601). Phys. Rev. A 9: No. 3, 1130-1135 (Mar 1974).

A formulation for the elastic scattering of electrons from molecules is presented based on an independent-particle model (IPM) and a fixed-nuclei approximation. Numerical computations are carried out for $e^- + N_2$ scattering. A phenomenological, energy-independent IPM

potential is found to be capable of qualitatively reproducing the total and differential cross sections over a wide range of energy, 10–500 eV. (auth)

8011 J-MATRIX METHOD: APPLICATION TO s-WAVE ELECTRON–HYDROGEN SCATTERING. Heller, E.J. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138); Yamani, H.A. Phys. Rev. A 9: No. 3, 1209-1214 (Mar 1974).

The method of the preceding paper is here applied to s-wave electron–hydrogen collisions. A pseudostate model is developed and applied to elastic and inelastic scattering above and below the ionization threshold, where we compare with the results of Burke and Mitchell. Additional calculations show the effect of Kato correction, the effect of the closed-channel asymptotic forms, and include a comparison with the results of Schwartz. (auth)

8012 NITROGEN TOTAL CROSS SECTION FOR ELECTRONS BELOW 2.0 eV. Baldwin, G.C. (Rensselaer Polytechnic Institute, Troy, New York 12181). Phys. Rev. A 9: No. 3, 1225-1229 (Mar 1974).

The total scattering cross section of molecular nitrogen for electrons in the energy range 0.3–1.6 eV has been measured absolutely by single-electron time-of-flight spectrometry, in which care has been taken to ensure positive removal of the scattered electrons and the gathering and reduction of data were in accordance with a thorough analysis of both statistical and systematic errors. The total cross section between 0.9 and 1.5 eV is found to be numerically equal to the momentum-transfer cross section of Englehardt, Phelps, and Risk; at lower energies it is appreciably lower than the momentum-transfer cross section. No evidence is found for the periodic structure reported in this cross section by Golden. (auth)

8013 FORMATION OF METASTABLE HYDROGEN ATOMS BY CHARGE EXCHANGE OF PROTONS IN CESIUM VAPOR. Tuan, V.N.; Gautherin, G. (Institut d'Electronique Fondamentale, Université Paris-XI, 91405 Orsay, France); Schlachter, A.S. Phys. Rev. A 9: No. 3, 1242-1251 (Mar 1974).

Formation of an intense beam of hydrogen atoms in the metastable 2s state is not only of basic interest, but is also useful for polarized-ion sources of the Lamb-shift type. The nearly resonant reaction $H^+ + Cs \rightarrow H(2s) + Cs^+$ is often used for this purpose. The fraction f of metastable atoms relative to the number of neutral atoms in all $n = 2$ states formed in the collision of a proton in a thin Cs-vapor target is reported here for the energy range 0.4–3.0 keV. An apparent maximum of $f = 0.43 \pm 0.03$ at 0.5 keV is found. For energies above 0.75 keV, $f = 0.25 \pm 0.01$, which would be expected if the $n = 2$ states of H are statistically populated. Previously reported values for σ_{+m}, the cross section for electron pickup in the metastable 2s state of hydrogen for $H^+ + Cs$ collisions, differ by two orders of magnitude for a given energy. It can be assumed that essentially all electron pickup is into the $n = 2$ states at low energy. Thus measured values of f can be multiplied by reported values of σ_{+0}, the cross section for electron pickup into any neutral state of the H atom, to find values for σ_{+m}. As this method is independent of calibration or normalization of the photon measurements, these values for σ_{+m} are more reliable than those previously reported. Our results for σ_{+m} are between 4.3×10^{-15} and 1.5×10^{-13} cm^2 in the energy range 0.5–3.0 keV. (auth)

8014 CORRELATED SCATTERING OF PROTONS IMPINGING AS HYDROGEN MOLECULES. Golovchenko, J.; Laegsgård, E. (Institute of Physics, University of Aarhus, Denmark). Phys. Rev. A 9: No. 3, 1215-1219 (Mar 1974).

The joint energy and angular-distribution function of protons transmitted through a thin foil when incident as 2-MeV H_2^+ has been measured. The experimental result is compared with simple calculations and satisfactory agreement is obtained. (auth)

8015 COMMENTS ON THE DISTORTED-WAVE BORN-APPROXIMATION CROSS SECTIONS FOR THE 2 ^{1}P EXCITATION OF He. Kim, Y. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. A 9: No. 3, 1462-1464 (Mar 1974).

The cross sections for the 2 ^{1}P excitation of He by electron impact have been calculated with the distorted-wave Born approximation (by Madison and Shelton) and with the plane-wave Born approximation (by Kim and Inokuti). Although the distorted-wave description of the incident electron results in greatly improved cross sections at large angles compared to the plane-wave method, this paper points out that a substantial part [(35–80) %] of the difference in the two methods for small-angle scattering comes from using different He wave functions in the two computations. (auth)

8016 EXCITATION OF N_2^+ IONS BY COLLISIONS WITH RARE-GAS ATOMS. Bregman-Reisler, H.; Doering, J.P. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). Phys. Rev. A 9: No. 3, 1152-1160 (Mar 1974).

Collisions of 0.3–5-keV ($4–20 \times 10^6$ cm/sec) N_2^+ ions with He and Ne targets have been studied by spectroscopic observation of the N_2^+ first-negative-emission spectrum. Vibrational excitation within the collisionally excited $X\ ^2\Sigma_g^+ \rightarrow B\ ^2\Sigma_u^+$ transition in N_2^+ was studied by a measurement of the relative band intensities of the $\Delta v = -1$ sequence of the first-negative system. Rotational excitation was examined by observation of the rotational line intensities of the (0, 0) first-negative band ($\lambda = 3914$ Å). Although the N_2^+ ions used for these experiments were highly vibrationally and rotationally excited by the ion-source discharge, the initial-energy distribution could be inferred from the N_2^+ emission spectra produced by high-velocity ($v > 1.2 \times 10^7$ cm/sec) collisions. At these velocities, populations of vibrational levels in the upper state were independent of projectile ion velocity and the rotational-energy distribution corresponded to a Boltzmann distribution at 3700 °K. At lower velocities, the population of high vibrational states increased with decreasing velocities and deviations from a Boltzmann distribution among rotational states were observed. Excitation to high rotational states increased monotonically with decreasing projectile-ion velocity. No differences in the rotational and vibrational excitation produced by He and Ne were observed. These results show that for some ion–molecule collisions there is vibrational and rotational excitation in the direct electronic excitation (non-charge-transfer) channel. (auth)

8017 COLLISIONS OF $F(^2P_{1/2})$ WITH H_2. Tully, J.C. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 60: No. 8, 3042-3050 (15 Apr 1974).

The role of spin–orbit and nonadiabatic effects in the reaction of F atoms with H_2 is discussed. Ground and excited FH_2 potential energy surfaces and the required interactions between them are computed by the diatomics-in-molecules method. Using an approximate semiclassical procedure, thermal rate constants for reaction and quenching of $F(^2P_{1/2})$ are estimated to be 1.2 and 8.4×10^{-12} cm^3 mol^{-1} · sec^{-1}, respectively. Since the former is about an order of magnitude smaller than previously reported calculations of the rate constant for reaction of $F(^2P_{1/2})$ with H_2, these results predict a substantial difference in reactivity between the $^2P_{3/2}$ and $^2P_{1/2}$ fine structure states of atomic fluorine. (auth)

8018 BREAKDOWN OF THE DIPOLE-BORN APPROXIMATION FOR PREDICTING ANGULAR DISTRIBUTIONS OF DISSOCIATION FRAGMENTS. Van Brunt, R.J. (University of Virginia, Charlottesville, Virginia 22901). J. Chem. Phys. 60: No. 8, 3064-3070 (15 Apr 1974).

A general expression is given for the form of the angular distribution of molecular fragments produced by electron-induced dissociation of diatomic molecules. A model for parametrizing angular distributions is introduced which allows investigation of higher-order multipole corrections to the simple dipole-Born approximation. It is found that higher-order terms are significant and even dominate the form of the angular distribution at electron energies near thresholds involving large momentum transfer. The model is useful in explaining previously observed deviations from the dipolar form and is applied to recent measurements of the angular distribution of O^- produced from O_2 by dissociative ion pair formation. When the effect of molecular rotation is included, the degree of anisotropy is found to diminish with increasing lifetime of the dissociating state, although general features of the distribution are preserved. (auth)

8019 ELECTRON ENERGY DEPENDENCE OF THE ENERGY AND ANGULAR DISTRIBUTIONS OF O^- FROM DISSOCIATIVE ION PAIR FORMATION IN O_2. Van Brunt, R.J. (University of Virginia, Charlottesville, Virginia 22901); Kieffer, L.J. J. Chem. Phys. 60: No. 8, 3057-3063 (15 Apr 1974).

The energy and angular distributions of O^- produced from O_2 by dissociative ion pair formation have been measured at selected incident electron energies from threshold to 100 eV. The kinetic energy distributions show well-defined maxima near 2.0 and 3.3 eV with appearance potentials, respectively, at 20.0 and 23.0 eV. The angular distributions are peaked in the forward and backward directions relative to electron beam and exhibit nondipolar structure. The shape of the distributions depends on electron energy, becoming more isotropic with increasing energy. An attempt has been made to explain the behavior of the angular distributions in terms of a superposition of final states using a multipole expansion of the differential cross section which includes the effects of higher-order partial waves. (auth)

8020 LARGE ANGLE INELASTIC SCATTERING OF Na^+ BY D_2. Dimpfl, W.L.; Mahan, B.H. (Department of Chemistry and Inorganic Materials Research Division of the Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). J. Chem. Phys. 60: No. 8, 3238-3250 (15 Apr 1974).

We report measurements of the inelasticity of the large angle scattering of Na^+ by D_2, HD, and H_2 in the initial relative energy range 0.74–16.9 eV. The interpretation of the vibrational inelasticity leads to the conclusion that perpendicular (C_{2v}) rather than collinear conformations of the Na^+–D_2 system produce the most intense inelastic scattering. The results of exact classical trajectory calculations which elucidate the effects of oscillator orientation and internal potential function on the inelasticity of collisions are presented. By fitting the calculated inelasticities to the experimental data, we have deduced both the energy and length parameters of a two term exponential repulsive potential for this system. (auth)

8021 COLLISION-INDUCED DISSOCIATION OF 0.4-2.6 keV H_2^+ AND D_2^+. Anderson, S.J. (Department of Physics, University of Western Australia, Nedlands, W. A. 6009, Australia). J. Chem. Phys. 60: No. 8, 3278-3292 (15 Apr 1974).

The energy distributions for protons (deuterons) from the collision-induced dissociation of H_2^+ (D_2^+) ions incident upon inert gas atom targets at energies in the range 0.4-2.6 keV have been measured. By modeling the ion source plasma an estimate of the vibrational distribution function of the primary beam has been obtained and used in a generalized spectrometer efficiency function to transform the spectra into the center-of-momentum frame of the ions. The resulting distributions are interpreted in terms of two main dissociation mechanisms: electronic excitation and polarization-induced vibrational-rotational excitation. Fine structure appearing in some spectra is attributed to rotational predissociation of a projectile-target complex. (auth)

8022 ON SEMIEMPIRICAL CROSS-SECTIONS FOR EXCITATION AND IONIZATION OF ATOMIC HYDROGEN BY ELECTRON IMPACT. Sampson, D.H.; Golden, L.B. (The Pennsylvania State University, University Park). Astrophys. J. 186: No. 2, 695-704 (1 Dec 1973).

Some deficiencies in recently proposed semiempirical cross-sections and rates are noted, and suggestions for accurate rates are made. (auth)

8023 EXCITATION OF METASTABLE ARGON AND HELIUM ATOMS BY ELECTRON IMPACT. Borst, W.L. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. A 9: No. 3, 1195-1200 (Mar 1974).

The excitation of argon and helium metastables by electron impact was studied in the energy range from threshold to about 50 eV with a time-of-flight method. The metastables were detected by Auger ejection of secondary electrons from a CuBeO surface. The argon cross section was obtained in two different ways yielding peak cross sections of 3.4×10^{-17} and 3.7×10^{-17} cm^2 at 22 eV, respectively. The estimated uncertainty for both values is a factor of 2. The helium cross section was measured with a trapped-electron method near threshold and found to have a peak value of $(6.2\pm2.0)\times10^{-18}$ cm^2 at the 25-eV maximum. The secondary-electron yields of the metastable detector used in this work are discussed in detail. The effect of metastable recoil is also discussed. Argon metastables suffer only negligible recoil because of their large atomic weight, but this is not the case for the lighter helium metastables. (auth)

8024 ROTATIONAL EXCITATION IN THE SMALL-ANGLE SCATTERING OF PROTONS FROM DIATOMIC MOLECULES. Udseth, H.; Giese, C.F. (Tate Laboratory of Physics, School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455); Gentry, W.R. J. Chem. Phys. 60: No. 8, 3051-3056 (15 Apr 1974).

Data for the small-angle scattering of protons from several polar and nonpolar molecules in the energy range 10 to 30 eV indicate that the presence of a dipole moment in the neutral molecule greatly enhances the rotational excitation process in ion-molecule collisions. Within our experimental energy resolution, no rotational excitation was observable for proton collisions with H_2, HD, D_2, or N_2. There is, however, some evidence for a small amount of rotational excitation of the dipolar molecule CO, and for HCl and HF large amounts of rotational excitation were observed. The inelasticity was found to be greater for HF than for HCl, consistent with the relative dipole moments and moments of inertia of the two molecules. The average excitation energies for HF measured at fixed scattering angle are qualitatively in agreement with a classical perturbation calculation for pure rotational excitation. For HCl, the classical perturbation calculation gives a rotational excitation energy much lower than the average observed translational energy loss, indicating that concurrent vibrational excitation, though not resolved in the presence of rotational excitation, may be relatively more important for HCl than for HF. (auth)

Atomic Theory

8025 BETHE-LAMB EQUATIONS. Grisaru, M. T. (Brandeis Univ., Waltham, MA); Pendelton, H. N.; Petrasso, R. Ann. Phys. (N. Y.); 79: No. 2, 518-541(Aug 1973).

A deviation is given of an effective Hamiltonian to be used in treating the decay of atomic states perturbed by a static applied field. This Hamiltonian is an improvement on that usually used in writing Bethe-Lamb equations. It includes the virtues of a Stark-perturbed golden rule method which has recently proved successful in treating decays of metastable states in helium, where the usual Bethe-Lamb approach fails. (auth)

8026 COMPRESSED ATOM. Rothberger, W. D.; Simon, G.; Zeller, G. R. (Technische Univ., Brunswick). Acta Phys. Acad. Sci. Hung.; 34: No. 2-3, 207-213(1973).

The compressed atom as a model for solid elements is treated within the Thomas-Fermi-Dirac-Weizsäcker statistical theory in two different ways: the TFDW-nonlinear differential equations are solved numerically with high accuracy, and a simpler variational procedure is developed, which leads essentially to the same numerical results. The equilibrium radii are calculated for several values of the atomic number Z. They do not vary with Z and are too small by a factor of 2. Density-pressure relations are discussed for several values of Z. Moreover, with the first calculational method accurate values for the various contributions to the energy and the total energy in the case Z = 55 are given for the compressed atom. (auth)

8027 SEMICLASSICAL TREATMENT OF MANY-LEVEL MOLECULAR SYSTEMS. Demchenko, V. V.; El-Siragy, N. M. (Atomic Energy Establishment, Cairo). Acta Phys. Acad. Sci. Hung.; 34: No. 2-3, 125-138(1973).

The interaction of a system of many-level molecules with an external electromagnetic field is investigated in a semiclassical approximation. The system-related nonlinear equations for the polarization vector and differences in the population of molecular energy levels are obtained. Although the investigation is carried out specifically for the case of a three-level molecule, the applicability of the method is not restricted by the number of energy levels. The applicability is tested by the problem of an oblique electromagnetic wave reflected from a dielectric, whose properties are specified by the equations of semiclassical theory. (auth)

8028 SINGLE PARTICLE ENERGY LEVEL SPECTRA FROM A FINITE SIZE CHARGE DISTRIBUTION. Edwards, D. Jr. (Univ. of Kentucky, Lexington). Acta Phys. Acad. Sci. Hung.; 34: No. 2-3, 115-123(1973).

The energy level spectra of an electron in the field of a small positive charge distribution was obtained by a nonperturbative technique. The spectra in the limit of small r_0 is seen to be hydrogenic for low lying levels while new features are seen in the spectra near the continuum. (auth)

8029 INTERATOMIC AUGER PROCESSES: EFFECTS ON LIFETIMES OF CORE HOLE STATES. Citrin, P. H. (Bell Telephone Labs., Inc., Murray Hill, NJ). Phys. Rev. Lett.; 31: No. 19, 1164-1167(5 Nov 1973).

The lifetimes of core hold states, as determined from x-ray photoemission measurements in a variety of materials, is shown to depend on, and in many cases be primarily determined by, an interatomic Auger mechanism involving transitions from ligand valence electrons. Interpretations of linewidths and other spectral features observed from those spectroscopies involving core holes must be re-evaluated in light of these processes. (auth)

8030 AUTOIONIZATION STATES OF ATOMS. Greiser, A. I. (Rostov-on-the-Don Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 130-132(1974). In Russian).

The formula for calculating the autoionization of atoms involves wave functions of the initial and final states. Autoionization states have a double nature, since they belong simultaneously to the discrete and continuous spectra. Hence variational methods of finding the wave functions of the bound state are incorrect. The present study attempts to calculate autoionization states and the probabilities of autoionization processes by considering integral equations for the excited states of atoms. The autoionization state is assigned a definite value for the binding energy and level width. An integral equation for a two-electron wave function is then written, and this equation is solved to obtain an expression for the probability of the autoionization process. (SJR)

8031 DEGENERATE RS PERTURBATION THEORY. Hirschfelder, J.O.; Certain, P.R. (Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 60: No. 3, 1118-1137 (1 Feb 1974).

A concise, systematic procedure is given for determining the Rayleigh-Schrödinger energies and wavefunctions of degenerate states to arbitrarily high orders even when the degeneracies of the various states are resolved in arbitrary orders. The procedure is expressed in terms of an iterative cycle in which the energy through the $(2n+1)$th order is expressed in terms of the partially determined wavefunction through the nth order. Both a direct and an operator derivation are given. The two approaches are equivalent and can be transcribed into each other. The direct approach deals with the wavefunctions (without the use of formal operators) and has the advantage that it resembles the usual treatment of nondegenerate perturbations and maintains close contact with the basic physics. In the operator approach, the wavefunctions are expressed in terms of infinite order operators which are determined by the successive resolution of the space of the zeroth-order functions. The operator treatment has some similarity to that of Choi (1969), but it is more closely related to that of either Hirschfelder (1969) or Silverstone-Holloway (1971). The operator expressions are useful for: double perturbations, expectation values of physical properties, and

problems involving finite dimensional Hilbert space (for example, wavefunctions approximated by linear basis sets). The use of variational principles for degenerate perturbation problems is discussed. (auth)

8032 SOME FORMAL ASPECTS OF THE LAMB SHIFT PROBLEM. Fox, J.A. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850 and Department of Physics, University of Utah, Salt Lake City, Utah 84112); Yennie, D.R. Ann. Phys. (N.Y.) 81: No. 2, 438-480 (Dec 1973).

Renormalization theory for bound states in the Furry picture is developed and formal expressions for level shifts are derived. The justification of the scattering approximation for the fourth order Lamb shift, originally shown by Kroll and Mills, is confirmed by a more compact formal treatment. (auth)

8033 VARIATIONAL TIME-DEPENDENT PERTURBATION SCHEME BASED ON THE HYDRODYNAMIC ANALOGY TO SCHRÖDINGER'S EQUATION. Aşkar, A.; Demiralp, M. (The Scientific and Technical Research Council, T.B.T.A.K., Insaat Fakultesi, Teknik Universite, Istanbul, Turkey). J. Chem. Phys. 60: No. 7, 2762-2766 (1 Apr 1974).

A variational principle correct through the second order is presented for time-dependent perturbations about a bound state. The formulation is based on the hydrodynamic analogy to quantum mechanics and is obtained by linearization of a general principle within the spirit of the acoustic approximation in classical fluid mechanics. The method requires the knowledge of the wavefunction for the unperturbed state only, unlike in the standard procedure of expansion in terms of a complete set of unperturbed wavefunctions. In dealing with the changes in the amplitude and phase of the wavefunction which are nonoscillatory, the method is expected to offer advantages over the usual variational perturbation methods which utilize the oscillatory wavefunctions directly. The method is applied to the calculation of the dynamic polarizability of the hydrogen atom and reasonable accuracy is obtained for an overly simple choice of basis functions. (auth)

8034 NEW DEVELOPMENTS IN THE APPLICATION OF HYPERSPHERICAL COORDINATES TO ATOMIC WAVE FUNCTIONS. Knirk, D.L. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). Phys. Rev. Lett. 32: No. 12, 651-654 (25 Mar 1974).

Spin and antisymmetry have been incorporated into a hyperspherical expansion of the many-electron wave function. This new expansion increases the range of exact and approximate results available for atomic systems. (auth)

8035 ATOMIC AND MOLECULAR CALCULATIONS WITH THE MODEL POTENTIAL METHOD. I. Bonifacic, V.; Huzinaga, S. (Department of Chemistry, The University of Alberta, Edmonton, Alberta, Canada). J. Chem. Phys. 60: No. 7, 2779-2786 (1 Apr 1974).

A new formulation of the model potential method is introduced for atoms and molecules. The model potential consists of a static local potential which simulates the effect of the Coulomb and the exchange of the atomic core electrons and a set of projection operators which prevents the collapse of the valence shell orbitals into the inner cores. A mathematical analysis of the proposed model potential is given as well as numerical results of calculations for the second row atoms Li through Ne. No essential difficulties are expected on obtaining satisfactory results for heavier atoms. Advantages in applying the present method to the all-valence-electron molecular calculations are also discussed. (auth)

8036 ANGULAR MOMENTUM ADAPTED WAVEFUNCTIONS AND THEIR REDUCED TRANSITION DENSITY MATRICES. Hunter, L.W. (Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 60: No. 7, 2670-2675 (1 Apr 1974).

The construction of angular momentum adapted kets is discussed first. The reduced transition density matrices of two arbitrary angular momentum adapted states are then expressed in terms of rotationally invariant components and in terms of "standard state" matrix elements. The latter results reduce to formulas obtained by McWeeny and Mizuno for spin angular momentum density matrices. (auth)

8037 COMMENT ON THE RADIATIVE LEVEL SHIFT IN THE NEOCLASSICAL RADIATION THEORY. van den Doel, R.; Kokkedee, J.J.J. (Department of Physics, Technological University, Delft, The Netherlands). Phys. Rev. A 9: No. 3, 1468-1469 (Mar 1974).

It is shown that, when spin currents are included in the neoclassical radiation theory of Jaynes et al., radiative atomic-level shifts are obtained, which, in the case of hydrogen, are in strong disagreement with experiment. (auth)

8038 VALIDITY AND MEANING OF THE MOMENTUM-TRANSLATION APPROXIMATION FOR BOUND STATES IN A RADIATION FIELD. Decoster, A. (Commissariat a l'Energie Atomique, Centre d'Etudes de Limeil, B.P. 27, 94190-Villeneuve St. Georges, France). Phys. Rev. A 9: No. 3, 1446-1449 (Mar 1974).

The conditions of validity for the momentum-translation approximation of Reiss are found much more stringent than was thought before: multiphotonic transitions induced by one strong field cannot be described by this method. First-order transitions between bound states dressed by a strong low-frequency field can be calculated, but the method gives nothing but a trivial result; only for the ionization of a dressed atom is the approximation found useful. (auth)

8039 EXCHANGE CORRECTIONS OF K X-RAY EMISSION RATES. Scofield, J.H. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. A 9: No. 3, 1041-1049 (Mar 1974).

Separate relativistic Hartree-Fock solutions for atoms in their initial and final states are used for calculating the radiative decay of a K-vacancy state. The matrix-element calculations include the exchange effects of the nonzero overlap of wave functions from different subshells. Results are presented for the filling of the vacancy by the p electrons for a set of elements from $Z = 10$ to $Z = 98$. The Hartree-Fock theory is also used for calculating the rates of production of multiple-vacancy states in the decay process. In contrast to earlier single-potential calculations, the calculated values of ratios of the rates of the K x-ray components are in good agreement with the experimental values. (auth)

8040 INVESTIGATION OF THE INFLUENCE OF ELECTRON-ELECTRON CORRELATION EFFECTS ON THE QUADRUPOLE ANTISHIELDING FACTOR OF POSITIVE IONS. Ray, S.N.; Lee, T.; Das, T.P. (Department of Physics, State University of New York, Albany, New York 12222); Sternheimer, R.M. Phys. Rev. A 9: No. 3, 1108-1111 (Mar 1974).

An investigation of the influence of self-consistency effects on the nuclear quadrupole antishielding factor γ_∞ in the case of Rb^+ and Cs^+ has been made. A new procedure is adopted to calculate this effect where use has been made of the first-order perturbed functions which had been utilized earlier to calculate the conventional γ_∞. It is found that the effect of consistency is within 1% in both cases. (auth)

8041 THIRD-ORDER STARK EFFECT: AN OPERATOR APPROACH. Tsai, W. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. A 9: No. 3, 1081-1086 (Mar 1974).

The third-order Stark effect is reexamined using an operator method presented by Schwinger. By observing an identity for the perturbed part of the Hamiltonian and by using commutation relations, we are able to obtain the energy spectra of hydrogenic atoms in a constant electric field without solving the Schrödinger equation. Our result confirms that of Doi and El-Sherbini. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 6332.

8042 UNSTEADY MAGNETIC LOW-SPEED SLIP FLOW IN THE BOUNDARY LAYER. Djukic, D. S. (Novi Sad Univ., Yugoslavia). Acta Mech.; 18: No. 1-2, 35-48(1973).

The influence of a uniform transverse magnetic field on the unsteady laminar boundary layer low-speed slip flow of a rarefied electrically conducting gas is considered. By means of the successive approximation method two problems are studied in detail. The first is an oscillating cylindrical body in a rarefied gas at rest. In the second problem the magnetic slip flow in the boundary layer around cylindrical bodies is studied for the case where the external speed of flow is exponentially dependent on time. (auth)

8043 I. MAGNETO-FLUID-MECHANIC TURBULENT FREE CONVECTION FLOW. II. Magneto- Fluid-Mechanic Vortex Street. Papailiou, D. D. Lafayette, IN; Purdue Univ. (1971). 278p. University Microfilms Order No. 74-4918.

Thesis (Ph. D.).

The results of an experimental investigation of a magneto-fluid-mechanic free convection turbulent boundary layer are presented. The boundary layer formed along an initially isothermally heated vertical flat plate which was one of the vertical walls of a stainless steel cell. The cell was filled with mercury. The heat flux applied to the heated wall was kept constant. Thermocouple and hot film probes were used in measuring temperature and temperature turbulent intensity distributions at different stations along the plate. The geometry of a vortex street, formed by the motion of a cylinder in a conducting fluid and its change, in the presence of a magnetic field was examined both theoretically and experimentally. (MHR)

8044 POTENTIAL FUNCTION OF A MAGNETOHYDRODYNAMIC EQUATION. Vacca, M. T. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 53: No. 5, 414-419(Nov 1972). (In Italian).

A differential equation is considered that appeared in a previous work on the hydrodynamic and magnetic potentials. From the preceding equation a solution is obtained having an analogy with a Newtonian volume potential. (auth)

8045 RADIATIVE AND CONVECTIVE HEAT TRANSFER IN A MAGNETIC FIELD. Egorov, A.D.; Karasev, A.B. (Moscow Physicotechnical Institute). High Temp. 11: No. 3, 485-492 (Jan 1974).

The radiative and convective heat transfer in the neighborhood of the forward stagnation point is investigated in the case of a body in a stationary flow in the presence of a magnetic field. The magnetic field freely penetrates the plasma, and the field lines are normal to the surface of the body in the flow region analyzed. It is shown that a magnetic field may reduce or intensify the radiant, and convective heat flows to the surface. When the body is placed in a bounded subsonic flow, the latter decrease with increase in the Stewart number in sufficiently weak fields and increase in strong fields. A sufficient condition for reduction of the radiant heat flux by a magnetic field is formulated. A parameter describing the relation between the inertia and viscosity forces is established as a result of a study of the boundary layer in the presence of intense injection in a strong magnetic field. The problem has also been solved in the radiative approximation, which proves to be quantitatively unacceptable even at an optical thickness of the boundary layer $T\lambda_r \gg 1$ owing to the large temperature gradient, as a result of which $(1/T)(dT/dy) > 1$(l is the radiation path). (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 8144.

8046 (COO-3071-81) RECENT RESEARCH, RESEARCH IN PROGRESS AND PLANS FOR EXPERIMENTAL AND THEORETICAL RESEARCH ACTIVITIES IN HIGH ENERGY PHYSICS, NUCLEAR PHYSICS AND ASTROPHYSICS. Progress Report. Volume II (Schedule 189). (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Apr 1974. Contract AT(11-1)-3071. 49p. Dep. NTIS $5.50.

This report consists of sections describing research, written by each physicist. The more significant items include the observation of neutrino-induced events without the production of muons, a study of inclusive deep inelastic scattering of hadrons, progress in the fabrication of the MPS facility, and observation of very large and intriguingly spaced signals in an underground neutrino detector. The descriptions of the research are quite general and present data only incidentally. A list of publications is included. (RWR)

8047 (RHEL-72-1(Vol.2)) PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON HIGH ENERGY COLLISIONS (STONY BROOK SERIES), OXFORD, ENGLAND, APRIL 5–7, 1972. Volume 2. Smith, J. R. (ed.). (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1972. 509p. (CONF-720419-P2).

The conference included 31 papers. Separate abstracts were prepared for each paper. (JFP)

For abstracts of individual papers see: 8048, 8049, 8060, 8068–8076, 8106–8115, 8135–8137, 8154, 8196–8198, 8221, and 8235.

8048 (RHEL-72-1(Vol. 2), pp 399-413) SCALING IN SEMI-INCLUSIVE EXPERIMENTS. Koba, Z.; Nielsen, H. B.; Olesen, P. (Univ. of Copenhagen). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

In bubble chamber experiments (in contrast to counter experiments) the semi-inclusive experiment $a + b \to c + (n-1)$ charged + anything neutral is more natural than the corresponding inclusive experiment $a + b \to c +$ anything. It is argued that the cross section for semi-inclusive experiments has very neat scaling properties. (auth)

8049 (RHEL-72-1(Vol.2), pp 451-472) POLARIZATION EFFECTS IN INCLUSIVE REACTIONS. Phillips, R. J. N.; Ringland, G. A.; Worden, R. P. (Rutherford High Energy Lab., Chilton, Eng.). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Various possible polarization measurements are distinguished, and their theoretical significance is discussed. It has previously been noticed that simple Regge pole models forbid polarization effects for the nonfragmenting particle. An absorptive mechanism is proposed which can give rise to polarization asymmetry in this limit and the distinctive predictions of this model are detailed. Comments are made on the implications of duality in the missing mass for these polarization effects. There are no dynamical reasons for polarization effects to be forbidden for the fragmenting particle or its fragment. The use of polarization effects in this kinematic region as a sensitive test of factorization is proposed. A number of experiments, with and without polarized targets, are suggested. (auth)

Electromagnetic

Refer also to abstract 6746.

8050 (DESY-74-14) π^0-ELECTROPRODUCTION ON HYDROGEN NEAR THRESHOLD AT FOUR-MOMENTUM TRANSFERS OF 0.2, 0.4, and 0.6 GeV^2. Brauel, P.; Buesser, F. W.; Canzler, T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Apr 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The reaction $e + p \to e + \pi^0 + p$ was measured near the one pion threshold, detecting the final electron and proton in coincidence for values of $q^2 + 0.2$, 0.4 and 0.6 GeV^2. The slope of the cross section at threshold is determined. The data are compared with those of the $e + p \to e + \pi^+ + n$ reaction, measured simultaneously, and with the results of pseudovector Born approximation and with dispersion theoretical calculations. (auth)

8051 ρ^0 PRODUCTION IN γd, γp, AND γn REACTIONS AT 7.5 GeV USING LINEARLY POLARIZED PHOTON BEAM. Alexander, G.; Gandsman, J.; Levy, A.; Lissauer, D.; Rosenstein, L. M. (Tel-Aviv Univ., Israel). Nucl. Phys.; B69: No. 3, 445-453(1974).

The reaction $\gamma d \to d\pi\pi$, $\gamma p \to p\pi\pi$ and $\gamma n \to n\pi\pi$ were studied in the SLAC 82" deuterium filled bubble chamber, exposed to a linearly polarized photon beam of 7.5 GeV. All three reactions are dominated by ρ^0 production. The differential cross section has a slope of ~6.5 GeV^{-2} for nucleon reactions and a slope of ~27 GeV^{-2} for coherent deuteron reactions. The behavior of the density matrix elements shows that ρ production conserves s-channel c.m.s. helicity and is dominated by natural parity exchange. (auth)

8052 ANALYSIS OF HEIGHT DEPENDENCE OF EAS. Antonov, R. A.; Ivanenko, I. P. (Moscow State Univ.). Yadern. Fiz.; 19: No. 4, 869-877(Apr 1974). (In Russian).

Results are presented of limiting estimates of intensity of EAS with the number of particles $>10^6$ at large heights with various assumptions on the primary interaction of the particle inducing the shower. Comparing the calculated intensity with the experimental EAS intensity for the observation level 212 g · cm^{-2} one shows that at interaction of particles with energy ~10^{15} eV an essential part of the energy of the primary particle ($\gtrsim$0.2) is spent for production of a great number of low energy γ-quanta ($E_\gamma \lesssim 10^{11}$ eV). Another alternative explanation of the high intensity of EAS is as follows. A more essential part of primary interactions at energies ~10^{15} eV have properties similar to those for the interactions at energies 10^{12} to 10^{13} eV, but a substantial part of the interactions ($\gtrsim$0.10 to 0.15) have extremely abnormal properties. For these interactions the most part of the primary energy (~10^{15} eV) is transferred to the low energy γ-quanta ($E_\gamma \lesssim 10^{11}$ eV). (auth)

8053 CONSISTENCY OF SLAC AND CERN DATA IN THE PARTON PICTURE. Bartelski, J.; Krolikowski, W. (Univ., Warsaw). Nuovo Cim.; 21A: No. 2, 265-276(21 May 1974).

It is shown that an excellent consistency between SLAC electron data and CERN neutrino data appears if a simple parton picture is assumed. (auth)

8054 STUDY OF OFF-SHELL EFFECTS IN p–p BREMSSTRAHLUNG AND D(p,2p)n EXPERIMENTS AT 156 MeV. Morlet, M.; Comparat, V.; Frascaria, R.; Marty, N.; Willis, A.; Willis, N. (Paris Univ., Orsay, France). pp 79-81 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceeding of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Off shell effects are important in many problems in nuclear physics, but the experiments carried out until now are not sensitive enough to test the off -hell behavior of nucleon–nucleon potentials. Two experimen..s were performed for conditions where the difference between off shell elements for different potentials should be enhanced. 1) A p–p–γ bremsstrahlung reaction at 156 MeV where both protons are emitted at forward angles ($\theta 1$ = 15°, $\theta 2$ = 18, 21, 24, 27°): the ratio k'/k of the outgoing to the ingoing relative momenta is then of about 0.4. 2) A D(p,2p)n reaction for high momentum transfer to the neutron; in particular kinematical conditions, the ratio k'/k (in the first order term of a multiple scattering expansion) is of 0.01. The differential cross sections for these reactions were measured: large discrepancies are found between these experimental and present theoretical values. (auth)

8055 ELECTROPRODUCTION OF PROTONS IN THE FORWARD DIRECTION. Bebek, C.J.; Brown, C.N.; Herzlinger, M.; Lichtenstein, C.A.; Pipkin, F.M.; Sisterson, L.K. (Cyclotron Laboratory, Harvard University, Cambridge, Massachusetts 02138); Andrews, D.; Berkelman, K.; Cassel, D.G.; Hartill, D.L. Phys. Rev. Lett. 32: No. 1, 27-30 (7 Jan 1974).

We present data on electroproduction of protons in which a proton moving in approximately the same direction as the virtual photon is detected. Measurements were made at data points with (Q^2, W) values of (0.6, 2.67), (1.2, 2.67), (2.0, 2.67), and (1.2, 2.15) in (GeV^2, GeV). The virtual photoproduction cross section for p + MM is studied as a function of scaling variables χ and $P_\perp{}^2$, azimuthal angle ϕ, Q^2, and W. (auth)

8056 ELECTROPRODUCTION OF K^+ MESONS IN THE FORWARD DIRECTION. Bebek, C.J.; Brown, C.N.; Herzlinger, M.;

Holmes, S.; Lichtenstein, C.A.; Pipkin, F.M.; Sisterson, L.K. (Cyclotron Laboratory, Harvard University, Cambridge, Massachusetts 02138); Andrews, D.; Berkelman, K.; Cassel, D.G.; Hartill, D.L.; Hicks, N. Phys. Rev. Lett. 32: No. 1, 21-24 (7 Jan 1974).

We present data on electroproduction of K^+ mesons off protons. Measurements were made at data points with nominal (Q^2, W) values of (0.6, 2.67), (1.2, 2.67), (2.0, 2.67), and (1.2, 2.15) in (GeV^2, GeV). The virtual photoproduction cross section for $K^+ + MM$ is studied as a function of missing mass, χ, P_1^2, Q^2, and W. The data show that the $K^+\Sigma^0$ cross section falls more rapidly than the $K^+\Lambda^0$ cross section as Q^2 increases. (auth)

8057 HIGH-ENERGY SINGLE-ARM INELASTIC e-p AND e-d SCATTERING AT 6 TO 10°. Poucher, J.S.; Breidenbach, M.; Ditzler, R.; Friedman, J.I.; Kendall, H.W. (Physics Department and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Bloom, E.D.; Cottrell, R.L.A.; Coward, D.H.; DeStaebler, H.; Jordan, C.L.; Piel, H.; Taylor, R.E. Phys. Rev. Lett. 32: No. 3, 118-121 (21 Jan 1974).

Differential cross sections for electron scattering from hydrogen and deuterium in the deep-inelastic region show that the neutron cross section is significantly smaller than the proton cross section over a large part of the kinematic region studied. Although νW_2^d differs in magnitude from νW_2^p, it exhibits a similar scaling behavior. (auth)

8058 MUON PAIR PRODUCTION BY PHOTON-PHOTON INTERACTIONS IN e^+e^- STORAGE RINGS. Barbiellini, G.; Orito, S.; Tsuru, T.; Visentin, R. (Laboratori Nazionali del Comitato Nazionale per l'Energia Nucleare, Frascati, Rome, Italy); Ceradini, F.; Conversi, M.; d'Angelo, S.; Ferrer, M.L.; Paoluzi, L.; Santonico, R. Phys. Rev. Lett. 32: No. 7, 385-388 (18 Feb 1974).

The photon-photon interaction has been investigated by e^+ and e^- collisions at about 2.7-GeV total energy. Evidence based on 34 well-identified events has been obtained for the process $e^+e^- \rightarrow e^+e^-\mu^+\mu^-$, hitherto unobserved. Such a process is found to occur in agreement with theoretical predictions based on the equivalent-photon approximation. Results on 74 events from the process $e^+e^- \rightarrow e^+e^+e^-$ are also reported. (auth)

8059 HADRON PRODUCTION BY ELECTRON-POSITRON ANNIHILATION AT 5 GeV CENTER-OF-MASS ENERGY. Tarnopolsky, G.; Eshelman, J.; Law, M.E.; Leong, J.; Newman, H.; Little, R.; Strauch, K.; Wilson, R. (Technion-Israel Institute of Technology, Haifa, Israel, and Cambridge Electron Accelerator, Cambridge, Massachusetts 02138, and Harvard University, Cambridge, Massachusetts 02138, and Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. Lett. 32: No. 8, 432-435 (25 Feb 1974).

We have measured the cross section σ for electron-positron annihilation into three or more hadrons, with at least two charged particles in the final state, at 5 GeV center-of-mass energy. We find a model-independent lower limit of $\sigma > 9.1 \pm 1.0$ nb; assuming invariant phase-space production of pions, we calculate the detection efficiency of our detector to be (45 ± 11) %, yielding a cross section $\sigma = 21 \pm 5$ nb. The average charged hadron multiplicity is found to be $\bar{n} = 4.3 \pm 0.6$. (auth)

Weak

8060 (RHEL-72-1(Vol.2), pp 214-217) SEARCH FOR LARGE TRANSVERSE MOMENTUM MUONS AT THE ISR. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

A search was made for muons with large transverse momentum as evidence for the existence of the intermediate boson or heavy virtual photons. If it is assumed that all 25 events are from beam-beam interactions, then a cross section of $2\ (10)^{-32}$ cm is implied for the production of muons with energy greater than 2.0 GeV, which is regarded as an upper limit. (JFP)

8061 NEUTRINO PROCESSES ON COLLIDING LEPTON BEAMS AT HIGH ENERGIES. Rekalo, A. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 12, 2058-2060(Dec 1973). (In Russian).

A hypothetical interaction of the neutrino with photons is proposed and the possibility of the study of this reaction in experiments on colliding e^-e^- and $\mu^-\mu^-$ beams is discussed. (tr-auth)

8062 OBSERVATION OF NEUTRINO-LIKE INTERACTIONS WITHOUT MUON OR ELECTRON IN GARGAMELLE NEUTRINO EXPERIMENT. Hassert, F. J. (Technische Hochschule, Aachen); Kabe, S.; Krenz, W. Nucl. Phys.; B73: No. 1, 1-22(1974).

Events induced by neutral particles and producing only hadrons, but no muon or electron, have been observed in the heavy liquid bubble chamber Gargamelle exposed to neutrino (ν) and antineutrino ($\bar{\nu}$) beams at CERN. A study of the various sources which could give rise to such events reveals that less than 20% could be attributed to neutrons or K^0_L. The events behave as expected if they arise from neutral current processes induced by neutrinos and antineutrinos. The ratio of the number of these events to the number of corresponding events with charged lepton is 0.22 ± 0.04 for ν and 0.43 ± 0.12 for $\bar{\nu}$. (auth)

8063 EXPERIMENTS AND PROBLEMS IN HIGH ENERGY NEUTRINO PHYSICS. Franzinetti, C. (Univ., Turin). pp 178-203 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

A discussion of some problems in high energy neutrino physics is presented and includes conservation of lepton charge, experimental results, heavy leptons as sources of neutrinos, and vacuum oscillations $\nu \rightleftharpoons \bar{\nu}$ and $\nu_\mu \rightleftharpoons \nu$. (JFP)

8064 MEASUREMENTS OF NEUTRINO AND ANTINEUTRINO CROSS SECTIONS AT HIGH ENERGIES. Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Ling, T.Y.; Mann, A.K.; Messing, F.; Piccioni, R.L.; Pilcher, J.; Reeder, D.D.; Rubbia, C.; Stefanski, R.; Sulak, L. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138 and Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104 and Department of Physics, University of Wisconsin, Madison, Wisconsin 53706 and National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. Lett. 32: No. 3, 125-128 (21 Jan 1974).

The dependence of the neutrino total cross section σ_ν on neutrino energy has been measured up to 160 GeV. The data are consistent with a linear dependence with slope $(0.58 \pm 0.25) \times 10^{-38}$ cm^2/GeV. The ratio of the antineutrino to the neutrino total cross section $\sigma_{\bar{\nu}}/\sigma_\nu$ has been found to be approximately constant up to 70 GeV at a value which is consistent with the numerical value of 1/3 expected for the scattering of neutrinos and antineutrinos by relativistic pointlike spin-1/2 fermions. (auth)

8065 STABILITY OF THE NEUTRINO. Reines, F.; Sobel, H.W.; Gurr, H.S. (Department of Physics, University of California, Irvine, Irvine, California 92664). Phys. Rev. Lett. 32: No. 4, 180-181 (28 Jan 1974).

Limits of $> 10^5$ astronomical units are set on the decay length of an electron antineutrino $\bar{\nu}_e$ via the process $\bar{\nu}_e \rightarrow \nu + \gamma$ for E_γ in the range 0.1-0.5 MeV using the results from a well-shielded detector in the vicinity of a fission reactor. This mode of decay is therefore ruled out as a possible explanation for the paucity of solar neutrinos revealed by the experiment of Davis. (auth)

Strong (Baryon-induced)

8066 (ITEF-936) INCLUSIVE PROCESSES IN REGGE SCHEME. Interpolation Formula and Experimental Data. 6. Interpolation Formula for Spectra. Lisin, V. L.; Ter Martiosyan, K. A.; Shabel'skii, Yu. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 20p. (In Russian). INIS.

A comparison was made of the experimental data on spectra of $\pi^\pm K^\pm$, p, and $\bar{p}$, obtained in pp collisions at incident proton momenta of 19 GeV/c, with the results of the data from the proposed interpolation formula. (tr-auth)

8067 (NAL-73-83-EXP) SEARCH FOR HEAVY MASS PARTICLES AND ANTIDEUTERON FLUX PRODUCED BY 300 GeV PROTONS ON BERYLLIUM. (National Accelerator Lab., Batavia, Ill. (USA)). Dec 1973. Contract AT(49-8)-3000. 9p. Dep. NTIS $4.00.

A search was made for heavy mass, long-lived particles and the antideuteron flux produced at 80 GeV/c by 300 GeV/c protons on beryllium was measured. (auth)

8068 (RHEL-72-1(Vol.2), pp 35-48) MEASUREMENT OF NEUTRON-PROTON CHARGE-EXCHANGE SCATTERING FROM 6 TO 29 GeV/c. Davis, M. B. (Princeton Univ., NJ); Gibbard, B. G.; Kreisler, M. N.; Dobrowolski, T.; Longo, M. J.; O'Brien, D. D.; Toohig, T. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The differential cross sections for neutron-proton charge-exchange scattering from 6 to 29 GeV/c are presented. The data, based on ~23,000 events, extend to four-momentum transfers $|u|$ as large as 1.0 $(GeV/c)^2$. The cross sections are characterized by a sharp peaking at small $|u|$ that persists to the highest momentum studied. There is evidence for structure near $|u| \sim 0.06$ $(GeV/c)^2$. A detailed discussion of the shape and momentum dependence of the cross sections is presented. (auth)

8069 (RHEL-72-1(Vol.2), pp 85-116) COMPARISON OF MOMENTUM SPECTRA OF SECONDARY PARTICLES PRODUCED

IN PROTON–PROTON COLLISIONS AT 14.2, 19.2, AND 24.0 GeV/c. Allaby, J. V.; Diddens, A. N.; Dobinson, R. W. (CERN, Geneva). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Results are reported of charged particle yields in pp collisions at 14.2, 19.2, and 24.0 GeV/c for secondary momenta above 4 GeV/c and laboratory angles between 10 and 150 mrad. The cross sections for the inclusive reactions involving the production of $\pi^{\pm}$, $K^{\pm}$, and $p^{\pm}$ are presented. The general features of the dependence of the data on transverse and longitudinal momentum, missing mass, and four-momentum transfer are discussed in the context of Feynman scaling and the approach to limiting distributions in the 10 to 30 GeV energy range. (auth)

8070 (RHEL-72-1(Vol.2), pp 117-139) INCLUSIVE PARTICLE PRODUCTION IN pp INTERACTIONS AT 12 AND 24 GeV/c. I. The Central Region. Mueck, H. J.; Schachter, M.; Selonke, F. (Univ., Bonn). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Double differential cross sections for the central region in the reactions $p + p \rightarrow \pi^-(\pi^+) +$ anything at 12 and 24 GeV/c are presented. Remarkable regularities are found when these cross sections are expressed as functions of y^* (the rapidity), p_T, and s. (JFP)

8071 (RHEL-72-1(Vol.2), pp 157-161) PRELIMINARY DETERMINATION OF THE AVERAGE CHARGED PARTICLE MULTIPLICITY AND OF THE TOPOLOGICAL CROSS SECTIONS IN 50 AND 69 GeV/c pp INTERACTIONS. Soviet-French Collaboration. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Topological cross sections and mean multiplicities are found for p + p interactions at 50 and 69 GeV/c in a hydrogen bubble chamber. (JFP)

8072 (RHEL-72-1(Vol.2), pp 180-196) SMALL-ANGLE PROTON–PROTON ELASTIC SCATTERING AT VERY HIGH ENERGIES ($460\ GeV^2 < s < 2900\ GeV^2$). Barbiellini, G.; Bozzo, M.; Darriulat, P. (CERN, Geneva). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The above processes were investigated at the CERN Intersecting Storage Rings (ISR). Results show a marked change of the slope parameter $b(t,s) = d/dt \ln (d\sigma/dt)$ around $-t \approx 0.10\ GeV^2$. The s- and t-dependence of b(t,s) were observed over the interval $460\ GeV^2 < s < 2900\ GeV^2$ and $0.02\ GeV^2 < t < 0.40\ GeV^2$. (auth)

8073 (RHEL-72-1(Vol.2), pp 197-213) INCLUSIVE PARTICLE PRODUCTION AT LARGE ANGLES MEASURED AT THE CERN ISR. British-Scandinavian ISR Collaboration. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Inclusive single-particle spectra are studied in proton–proton collisions at 23.3 to 53.0 GeV in colliding beams. The pion double differential cross section was measured. Also cross sections for protons, antiprotons and kaons are shown. (JFP)

8074 (RHEL-72-1(Vol.2), pp 220-229) MEASUREMENT OF THE TOTAL CROSS SECTIONS FOR Λ HYPERON INTERACTIONS ON PROTONS AND NEUTRONS IN THE MOMENTUM RANGE FROM 6 TO 21 GeV/c. Gjesdal, S. (CERN, Geneva); Presser, G.; Steffen, P.; Steinberger, J.; Vannucci, F.; Wahl, H.; Kleinknecht, K.; Lueth, V.; Zech, G. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The Λp, Λn, $\bar{\Lambda} p$, and $\bar{\Lambda} n$ total cross sections were measured in the Λ momentum interval 6 to 21 GeV/c. Within the experimental uncertainties the cross sections are momentum-independent in this interval and the momentum-averaged cross sections are found to be: $\sigma(\Lambda p) = 34.6 \pm 0.4$ mb, $\sigma(\Lambda n) = 34.0 \pm 0.8$ mb, $\sigma(\bar{\Lambda} p) = 56 \pm 11$ mb, and $\sigma(\bar{\Lambda} n) = 46 \pm 20$ mb. The first two results are in agreement with charge symmetry, and with simple quark model sum rules applied to previous results on pp, K^-n, and π^+p total cross sections. (auth)

8075 (RHEL-72-1(Vol.2), pp 327-346) DIFFRACTION DISSOCIATION MODEL OF HIGH ENERGY HADRON INTERACTIONS. Adair, R. K. (Yale Univ., New Haven). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

At moderate energies it is observed that the total cross sections for hadron interactions which can be defined in terms of the exchange between the incident and target hadron of a state with the quantum numbers of the vacuum are nearly independent of energy while all other exchange interactions fall off rapidly with energy. This result suggests that it may be interesting to examine the possibility that such vacuum exchange processes are dominant at sufficiently high energies. The multiplicities and cross sections for p + p and π + p interactions are discussed. (JFP)

8076 (RHEL-72-1(Vol.2), pp 366-377) TWO PARTICLE CORRELATIONS IN INCLUSIVE pp INTERACTIONS BETWEEN 13 AND 28 GeV/c. Berger, E. L. (Argonne National Lab., IL); Oh, B. Y.; Smith, G. A. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

New data are presented on π^- production in inclusive pp interactions at 13, 18, 21, 24 and 28.5 GeV/c. Mean values $\langle n \rangle$, $\langle n(n-1) \rangle$, and the associated multiplicity $\langle n(y)-1 \rangle$ are given as a function of s. Single- and two-particle spectra are presented. Strong correlations found between π's are interpreted as a simple manifestation of small inelasticity, observed previously in single particle spectra. The data are in good agreement with predictions of the Nova model. (auth)

8077 (TRI-71-7) PARTICLE FLUXES FROM A DEUTERIUM TARGET BOMBARDED BY 500-MeV PROTONS. Simon, W. G. (Alberta Univ., Edmonton (Canada)). Jul 1971. 19p. INIS.

The fluxes of particles expected from a neutron producing liquid deuterium target in the TRIUMF proton area under typical operating conditions are estimated. These results are expected to be used for shielding purposes and for estimating the particle fluxes returning upstream in the beam tube. Pion producing reactions are considered only insofar as they produce neutrons in the backward directions. This should not result in a significant underestimate for the shielding required in forward directions since these reactions comprise only about 10% of the total cross section and the reaction products are generally of low energy. Results are given in terms of effective cross sections for producing particles of various types and for the particle fluxes at 1 meter from a 1.7 gm/cm² (10 cm) LD target bombarded with a 10μA beam of 500 MeV protons. (auth)

8078 MECHANISM FOR THE PRODUCTION OF PIONS IN THE REACTION pp → NNπ AT A MOMENTUM OF 10 GeV/c. Takibaev, Zh. S.; Boos, E. G.; Temiraliev, T. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 24-29(1973). (In Russian).

The cross section for the formation of resonances was reported for the reaction pp → NNπ. The light isobar Δ_{1236} was formed with the largest cross section. The experimental differential cross sections $d\sigma/d|t'|$ for the processes pp → $N\Delta_{1236}$, pp → $pN^*_{1400,1518}$, and pp → pN^*_{1688} were compared with the predictions of different theoretical models. The experimental distribution of $d\sigma/d|t'|$ for the reaction pp → $N\Delta_{1236}$ agreed well with the calculations obtained in the framework of the pole Regge model with consideration of the exchange of one pion trajectory. (tr-auth)

8079 SIMULATION OF THE THREE-PRONGED pn INTERACTION AT MOMENTUM OF 19.2 GeV/c. Boos, E. G.; Zhautykov, B. O.; Mosienko, A. M. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 68-72(1973). (In Russian).

The results of the simulation of reactions in the 2-m deuteron bubble chamber at primary proton momentum of 19.20 ± 0.05 GeV/c were analyzed. The generation of events was done by means of the FORS program in which consideration is made of the experimental angular distributions of the nucleons in the center-of-mass system of the interaction and of the Fermi motion of the neutron target on the deuteron. It was shown that with selected simulation conditions a reliable discrimination of the channel without formation of a neutral particle is possible, and channels with one neutral particle can be discriminated with a probability of 67%. (tr-auth)

8080 CONTRIBUTION OF STOPPING PROTONS TO THE RISE IN THE PROTON–PROTON INELASTIC CROSS SECTION AT HIGH ENERGIES. Erne, F. C. (Stichting Fundamental Onderzoek der Materie, Utrecht). Phys. Lett.; 49B: No. 4, 356-360(29 Apr 1974).

It is shown that existing production data on protons and antiprotons from proton–proton collisions allow for a substantial contribution to the rise in the pp inelastic cross section from incoming protons which lose almost all their energy (stopping protons). (auth)

8081 CORRELATIONS BETWEEN A FORWARD PROTON AND CENTRAL PION IN PP COLLISIONS AT ISR. Squires, E. J.; Webber, D. M. (Univ. of Durham, Eng.). Nuovo Cim.; 21A: No. 2, 413-416(21 May 1974).

It is shown that the apparent long-range correlation between a forward diffractively produced proton and a central pion observed in pp collisions at high energies is kinematical in origin and that a very simple model fits the data. (auth)

8082 POSITIVE PARTICLE PRODUCTION IN THE FRAGMENTATION REGION AT THE CERN ISR. Albrow, M. G. (CERN, Geneva); Bacchus, A.; Barber, D. P. Nucl. Phys.; B73: No. 1, 40-56(1974).

Cross sections for the production of positive pions, kaons and protons in proton–proton collisions at the CERN ISR were measured. These measurements extend to transverse momenta p_T of 2.5 GeV and span the range in $x = 2p_L/\sqrt{s}$ between 0.3 and 0.8. For transverse momenta larger than ~1 GeV the cross sections show an increase relative to low-energy data, but are consistent with scaling within the energy range measured here, $31 < \sqrt{s} < 63$ GeV. (auth)

8083 MISSING MASS SPECTRA IN pp INELASTIC SCATTERING AT TOTAL ENERGIES OF 23 GeV AND 31 GeV. Albrow, M. G. (CERN, Geneva); Bacchus, A.; Barber, D. P. Nucl. Phys.; B72: No. 3, 376-392(1974).

Results are reported of measurements of the momentum spectra of protons emitted at small angles in inelastic reactions at the CERN ISR. The data are for total energies $s^{\frac{1}{2}}$ of 23 GeV and 31 GeV. The structure of the peak at low values of the missing mass M (of the system recoiling against the observed proton) is studied. The missing mass distributions have the form $(M^2)^{-B(t)}$ where t is the four-momentum transfer squared. B(t) drops from 0.98 ± 0.06 at $t = -0.15$ GeV^2 to 0.20 ± 0.15 at $t = -1.65$ GeV^2. The results are compared with a simple triple-Regge formula. (auth)

8084 BREMSSTRAHLUNC EMISSION IN NUCLEAR SCATTERING. Wolfli, W.; Hall, J.; Mueller, R.; Peyer, U.; Suter, M. (Eidgenoessische Technische Hochschule, Zurich). pp 96-99 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The phenomenon of bremsstrahlung emission in particle scattering was studied for several cases: (p,α), (d,p), and (α,α) scattering. They were investigated through the use of the ETH tandem accelerator and a specially designed 3-parameter electronic system with a time resolution (FWHM) of less than 1 ns over the whole energy range of interest. Differential cross sections were measured for Ep = 7 to 12 MeV, Ed = 7 to 9 MeV and Eα = 12.5 to 19 MeV. The data were compared to a model independent theory. It is found that the rescattering effects accounts for about ½ of the measured cross section for [p,α] scattering. (auth)

8085 NEUTRON–NEUTRON SCATTERING PARAMETERS FROM AN ANALYSIS OF THE REACTION N + D → N + N + p BY AN EXACT THREE BODY CALCULATION. Zeitniz, B. (Univ., Hamburg); Maschuw, R.; Suhr, P.; Ebenhoeh, W. pp 117-121 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceeding of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

In a kinematically complete experiment on the reaction ^{2}H(n,2n)H neutron–neutron and neutron–proton final state interactions at very similar kinematic conditions were observed. The experimental data were analyzed by the exact three-body calculations. The results were obtained by a new extensive Monte-Carlo analysis. The scattering length and effective range were found to be $A_{nn} = -16.1 \pm 0.9$ fm and $\Gamma_{nn} = 3.4 \pm 0.6$ fm. (auth)

8086 VALIDITY OF THE IMPULSE APPROXIMATION FOR THE D(n,p)2n REACTION AT 14 MeV. Shirato, S.; Saitoh, K.; Koori, N. (Rikkyo Univ., Tokyo). pp 114-116 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceeding of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The values of the $^1S_0$ n–n scattering length a_{nn} extracted until now from the energy spectrum of protons from the D(n,p)2n reaction have varied from −14 fm to −24 fm for kinematically incomplete experiments, while they have been consistent with the prediction of Noyes and Lipinski (−17 fm) for kinematically complete experiments. The break-up proton spectrum at 14.1 MeV. The spectrum was observed at the average proton angle of 4.0° with a counter telescope consisting of 200 μm- and 2 mm-thick Si(Li) detectors and three proportional counters, in which a (CD_2) radiator 5.09 mg/cm^2 thick was inserted. The separation of protons from recoil deuterons was completely made by utilizing the two-parameter analysis. The energy resolution was less than 67.6 keV. The detailed comparison of the measured spectrum with the calculated ones based on the impulse approximation was performed to check the validity of this approximation at 14 MeV. The calculation was done as a function of a_{nn} and the effective range r_s. The scattering length was found to be -19.3 ± 0.8 fm. It is suggested that the impulse approximation is not a valid one at this energy. (auth)

8087 NUCLEON–NUCLEON SCATTERING LENGTHS FROM INCOMPLETE NUCLEON–DEUTERON BREAKUP EXPERIMENTS. Davis, J. C.; Anderson, J. D.; Grimes, S. M.; Wong, C. (Univ. of California, Livermore). pp 104-107 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Determination of the neutron–neutron scattering length a_{nn} from either kinematically complete or incomplete experiments is based upon the success with which the known pp or np scattering lengths can be extracted from such experiments. In the case of nucleon-induced breakup of the deuteron, the final state enhancement effects observed at forward angles in incomplete experiments cannot be analyzed with the Watson–Migdal formalism because of the extended structure of the deuteron. However, the impulse approximation was shown to give a fair representation of small angle final state interaction peaks observed in these reactions below 50 MeV. Although many attempts have been made to extract the nn scattering from ^{2}H(n,p)2n spectra, less work has been done to check the formalism by obtaining the pp scattering length from ^{2}H(p,n)2p spectra. Measurements of ^{2}H(p,n)2p spectra at a lab angle of 3.5° were made at nine proton energies between 16 and 26 MeV. Experimental spectra taken at 19 and 26 MeV and theoretical spectra calculated from the impulse approximation formalism of Phillips are given. The value of the pp scattering length a_{pp} giving the best fit to the data was determined by setting equal the areas of experimental and calculated spectra integrated to 2 MeV relative energy in the two proton system and minimizing chi square as a function of scattering length. Averaging together the results obtained at each energy yields a pp scattering length of -6.6 ± 0.5 fm. (auth)

8088 DETERMINATION OF THE NEUTRON–NEUTRON SCATTERING LENGTH FROM A KINEMATICALLY COMPLETE EXPERIMENT ON THE D(n,np)n REACTION AT 130 MeV. McNaughton, M. W. (King's Coll., London); Griffiths, R. J.; Stewart, N. M.; Edginton, J. A.; May, M. P.; Blair, I. M.; Bonner, B. E. pp 108-111 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Kinematically complete data were obtained from the d(n,np)n reaction over a range of final state angles, and a range of incident energies. Incident neutrons from 50 to 150 MeV were collimated onto a target of liquid deuterium. Two particles, a neutron and proton, were detected in coincidence in the final state at any of five proton angles and eight neutron angles, defining forty pairs of final state angles. Each event was kinematically overdetermined by measuring the times of flight of the incident neutron, the final state neutron and the final state proton in addition to the energy (full energy detector pulse height) of the final state proton. An analysis is being attempted of those pairs of angles for which the n–n final state interaction (FSI) process is optimized, using Watson Migdal theory. (auth)

8089 NEUTRON–NEUTRON FINAL STATE INTERACTION IN THE REACTION D(n,2n)p. Breunlich, W. H.; Tagesen, S.; Bertl, W.; Chaloupka, A. (Univ., Vienna). pp 100-103 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Experimental results on nucleon–nucleon scattering lengths as well as theoretical results from the Amado Model show that for kinematically complete experiments on nucleon–nucleon final-state-interaction (FSI) the Watson–Migdal-expression can be a good approximation. The quality of the approximation, however, is not as good as should be demanded for the determination of the neutron–neutron scattering length. Improved information about scattering lengths can be expected if the reaction amplitudes obtained in an exact three-body calculation are used in the analysis. A kinematically complete experiment of the reaction D(n,2n)p was performed at an incident neutron energy of 14.17 MeV detecting both of the emitted neutrons. The theoretical analysis was done with the Amado model and with a conventional Watson–Migdal-approach. Absolute cross sections and the neutron–neutron-scattering length a_{nn} were determined. The theoretical analysis was carried out using Monte Carlo analysis. Values of a_{nn} calculated with both the models are in good agreement, their difference being less than the experimental error. The validity of the result and possible systematic errors are discussed. (auth)

8090 EXCITED STATES OF HYPERNUCLEI. Bamberger, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Faessler, M. A.; Lynen, U.; Ritter, H. G.; Povh, B.; Soergel, V.; Piekarz, H.; Piekarz, J. pp 182-187 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international Conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The experimental investigation of hypernuclei up to now was done using emulsions and bubble chambers and therefore, with only 2 exemptions, all existing knowledge concerns hypernuclear ground states. The investigation of excited states in general is only possible using counter techniques, but these experiments could not be performed due to the low intensity of available K^--beams. At CERN a low energetic separated K-beam was built, at which 1000 K^--mesons per burst can be stopped in a target of 6 g/cm^2 thickness. At this beam an experiment looking for γ-transitions in excited hypernuclei was performed. In order to eliminate background γ-radiation arising from K^- annihilation and de-excitation of residual nuclei, only light targets were used, namely ^{6}Li, ^{7}Li, ^{9}Be, ^{12}C, and ^{16}O. Hypernuclear transitions were found in $^{\Lambda}_{\Lambda}$H and $^{\Lambda}_{\Lambda}$He and possible transitions in ^{6}Li and ^{7}Li. The scattering lengths for the singlet and triplet states of $^{\Lambda}_{\Lambda}$He are found to be $a_s = -2.3$ fm and $a_t = -1.2$ fm. (auth)

8091 ELASTIC SCATTERING EXPERIMENTS WITH HIGH ENERGY PROTONS. Schluepmann, K. (CERN, Geneva). pp 153-177 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

It is pointed out that by the construction of the CERN intersecting storage rings the effort and the interest in proton scattering studies has been multiplied. Various properties of proton elastic scattering are discussed. (JFP)

8092 PRODUCTION OF LARGE-TRANSVERSE-MOMENTUM GAMMA RAYS IN PP COLLISIONS FROM 50 TO 400 GeV. Carey, D.C.; Goldberg, M.; Johnson, J.R.; Ritchie, D.J.; Roberts, A.; Shafer, R.; Theriot, D.; von Goeler, E.; Walker, J.K.; Wong, M. (National Accelerator Laboratory, Batavia, Illinois 60510); Taylor, F.E. Phys. Rev. Lett. 32: No. 1, 24-27 (7 Jan 1974).

We have measured $d^2\sigma_\gamma/dkd\Omega$ for the reaction $p + p \rightarrow \gamma +$ anything at incident proton energies from 50 to 400 GeV. The experiment was performed in the National Accelerator Laboratory internal target area, using a lead-glass total-absorption counter. The cross sections show a deviation from simple exponential behavior in p_t for incident proton energies above 50 GeV and p_t greater than about 1 GeV/c. We present preliminary results on the energy dependence of this effect. (auth)

8093 DOUBLE-POMERON-EXCHANGE CONTRIBUTION TO THE REACTION $pp \rightarrow pp\pi^+\pi^-$ AT 205 GeV/c. Derrick, M.; Musgrave, B.; Schreiner, P.; Yuta, H. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 32: No. 2, 80-82 (14 Jan 1974).

The reaction $pp \rightarrow pp\pi^+\pi^-$ at 205 GeV/c is analyzed in terms of the rapidities of the secondary particles to measure the contribution of the double-Pomeron exchange process. Using a sample of 191 events, we estimate the maximum possible contribution for this process to be 44 μb for the region of πp effective mass greater than 2.0 GeV in a total cross section of 680 $\pm$ 140 μb. (auth)

8094 MEASUREMENT OF ELASTIC PROTON-PROTON SCATTERING IN PURE INITIAL-SPIN STATES. O'Fallon, J.R. (Department of Physics, St. Louis University, St. Louis, Missouri 63103); Parker, E.F.; Ratner, L.G.; Fernow, R.C.; Gray, S.W.; Krisch, A.D.; Miettinen, H.E.; Roberts, J.B. Phys. Rev. Lett. 32: No. 2, 77-79 (14 Jan 1974).

An experiment was done using an accelerated polarized proton beam and a polarized proton target. The elastic cross section for proton-proton scattering at 6.0 GeV/c and $P_\perp^2 = 0.5 - 1.6$ (GeV/c)^2 was measured in the spin states $\uparrow\uparrow$, $\downarrow\downarrow$, and $\uparrow\downarrow$ perpendicular to the scattering plane. The cross sections were found to be unequal by up to a factor of 2. (auth)

8095 SMALL-MOMENTUM-TRANSFER p-p INELASTIC SCATTERING AT 300 GeV/c. Childress, S.; Franzini, P. (Columbia University, New York, New York 10027); Lee-Franzini, J.; McCarthy, R.; Schamberger, R.D. Jr. Phys. Rev. Lett. 32: No. 7, 389-392 (18 Feb 1974).

We have performed an experiment on p-p inelastic scattering at National Accelerator Laboratory to study the reaction $p + p \rightarrow p + X$. We cover the range in $|t|$ from 0.019 to 0.17 (GeV/c)^2 by measuring the low-energy recoiling protons. The range in M_X^2 measured is from 0 to 60 GeV^2. The "diffractive" cross section is determined to be in the range $3.2 < \sigma < 4.7$ mb. Unexpected behavior is observed at low $|t|$ for $8 < M_X^2 < 14$ GeV^2. (auth)

8096 HEAVY-PARTICLE PRODUCTION IN 300-GeV/c PROTON/TUNGSTEN COLLISIONS. Appel, J.A.; Bourquin, M.H.; Gaines, I.; Lederman, L.M.; Paar, H.P.; Repellin, J.; Saxon, D.H.; Yoh, J.K. (Columbia University, New York, New York 10027); Brown, B.C.; Gaillard, J. Phys. Rev. Lett. 32: No. 8, 428-432 (25 Feb 1974).

A search was made for massive particles produced by 300-GeV/c protons. A 1.1-km flight path through a beam transport system permitted the measurement of the production of heavy particles for secondary momenta of 25 to 200 GeV/c. No counts were obtained for masses greater than 2 GeV/c^2 among 5.5×10^7 secondary particles. Cross sections are presented for forward production of π^+, π^-, p, $\bar{p}$, d, and $\bar{d}$. (auth)

8097 MEASUREMENT OF THE p-p TOTAL CROSS SECTION AT 200 AND 300 GeV/c. Gustafson, H.R.; Jones, L.W.; Longo, M.J. (University of Michigan, Ann Arbor, Michigan 48104); Cork, B. Phys. Rev. Lett. 32: No. 8, 441-444 (25 Feb 1974).

We have measured total cross sections for p-p scattering with the results $\sigma_T = 40.42 \pm 0.27$ mb at 200 GeV/c and 40.40 ± 0.28 mb at 300 GeV/c. Our 300-GeV/c result is significantly higher than published data from the CERN intersecting storage rings. Our data, taken together with the Serpukhov data, indicate that the cross section rises $\simeq$2 mb between 60 and 250 GeV. The variation of the cross section with energy may be more complicated than the a + b $\ln^2 s$ behavior commonly assumed for $E_{lab} \gtrsim 50$ GeV. (auth)

8098 OBSERVATION OF STRUCTURE IN $\bar{p}p$ AND $\bar{p}d$ TOTAL CROSS SECTIONS BELOW 1.1 GeV/c. Carroll, A.S.; Chiang, I.; Kycia, T.F.; Li, K.K.; Mazur, P.O.; Michael, D.N.; Mockett, P.; Rahm, D.C.; Rubinstein, R. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 32: No. 5, 247-250 (4 Feb 1974).

Total cross sections of $\bar{p}p$ and $\bar{p}d$ have been measured between 360 and 1050 MeV/c, with high statistical precision. Structures are observed in both cross sections at about the same momenta. For $\bar{p}p$, the central mass is 1932 $\pm$ 2 MeV/c^2, and a fit to the data with a simple Breit-Wigner resonance plus background gives $\Gamma = 9^{+4}_{-3}$ MeV/c^2. The data suggest that the structures are in the isospin-1 state. (auth)

8099 MULTIPLICITIES IN 100-GeV/c π^+p AND pp INTERACTIONS USING A TAGGED BEAM. Erwin, J.; Klema, J.H.; Ko, W.; Lander, R.L.; Pellett, D.E.; Yager, P.M. (Department of Physics, University of California, Davis, California 95616); Alston-Garnjost, M. Phys. Rev. Lett. 32: No. 5, 254-257 (4 Feb 1974).

π^+p and pp interactions at 100 GeV/c are studied in the National Accelerator Laboratory 30-in. bubble chamber with a tagged beam. Charged multiplicities in π^+p and pp interactions are compared. The average inelastic multiplicity of π^+p interactions is higher than for pp interactions (6.80 ± 0.14 versus 6.49 ± 0.10). However, negative particle multiplicities for events with more than six charged particles follow Poisson statistics with similar means, 2.56 ± 0.09 and 2.61 ± 0.08, for π^+p and pp interactions. (auth)

8100 DIFFRACTIVE COMPONENT IN pp COLLISIONS AT 102 AND 405 GeV. Chapman, J.W.; Cooper, J.W.; Green, N.; Seidl, A.A.; Vender Velde, J.C. (University of Michigan, Ann Arbor, Michigan 48104); Bromberg, C.M.; Cohen, D.; Ferbel, T.; Slattery, P. Phys. Rev. Lett. 32: No. 5, 257-260 (4 Feb 1974).

We study the diffractive component in pp collisions at 102 and 405 GeV and examine its energy dependence in M^2 and x variables. The total cross section for $|x| > 0.9$ remains approximately constant: 6.6 ± 0.5 and 6.8 ± 0.7 mb at the two energies. However, both $d\sigma/dx$ and $d\sigma/dM^2$ strong energy dependence within the $|x| > 0.9$ region. The energy and M^2 dependences of $d\sigma/dM^2$ do not have the characteristics of a triple-Pomeron term for $0.90 < |x| < 0.99$. (auth)

Strong (Meson-induced)

8101 (COO-1195-285) A_2-A_1 INTERFERENCE PHASE. Ascoli, G.; Jones, L. M.; Klanner, R.; Kruse, U. E.; Wyld, H. W. (Illinois Univ., Urbana (USA)). Apr 1974. Contract AT(11-1)-1195. 15p. (ILL-(TH)-74-5). Dep. NTIS $4.00.

The A_2-A_1 phase difference observed in $\pi^-p \rightarrow \pi^+\pi^-\pi^-p$ is compared with the A_2^- phase from a Regge fit to the $d\sigma/dt$ data for A_2^- and the A_1^- phase given by a Reggeized Deck model. The agreement (~30°) depends crucially on the contribution of the Reggeized pion propagator to the A_1 phase and requires equal signs for the f and P residues in the A_2 amplitude. (auth)

8102 (CRN-HE-73-4) COHERENT PRODUCTION OF 2, 3, 4, AND 5 PI MESONS BY π^+ NUCLEI INTERACTIONS AT 11.7 GeV/c. Arnold, R.; Engel, J. P.; Escoubes, B. (Centre National

de la Recherche Scientifique, 67 –Strasbourg (France). Centre de Recherches Nucleaires). May 1973. 25p.

Pion-plus nuclei coherent interactions with 2, 3, 4, and 5 pions in the final state were sought in a heavy liquid bubble chamber experiment with direct detection of π^0. Abundant coherent production was observed in the three pion channels $\pi^+\pi^+\pi^-$ and $\pi^+\pi^0\pi^0$, essentially in the A_1 mass region, but the available data were insufficient to establish coherence in the 2, 4, and 5π channels, for which upper cross section limits are given. The branching ratio GAMMA ($A_1 \rightarrow rho^+\pi^0$)/GAMMA ($A_1 \rightarrow rho^0\pi^+$) was found to be equal to 0.67 ± 0.22. (auth)

8103 (FRNC-TH-187) STUDY OF THE $K^+p \rightarrow K^0_{892}\ \Delta^{++}_{1236}$ REACTION AT 2.1, 2.3, 2.5, AND 2.7 GeV/c. Borg, A. (Paris-6 Univ., 75 (France)). 1970. 88p. INIS.

Studies of the $K^+p \rightarrow K^+p\pi^+\pi^-$ reaction with the incident K^+ having momenta of 2.11, 2.31, 2.53 and 2.72 GeV/c established the existence of an abundant production of $K^0_{892}\ \Delta^{++}_{1236}$ in the final state. The production mechanism of this reaction was studied by examining the differential cross sections using the single Regge pole exchange model and the analysis of the angular distributions of the disintegration products of each of these resonances. An overall interpretation of these distributions enabled the angular correlation problem to be studied. Certain hypotheses of the quark model were also verified. (auth)

8104 (IFA-HE-81-1972) BRANCHING RATIOS FOR TOTAL INCLUSIVE CROSS-SECTIONS. Bales, E.; Balea, O.; Boldea, V.; Cristea, D.; Felea, S.; Nicorovici, N.; Pantea, D.; Ponta, T.; Besliu, C.; Cotorobai, F. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 8p. Dep. NTIS (US Sales Only) $4.00.

Under the assumptions of the additive quark model, supplemented by a statistical picture, the branching ratios of the total inclusive cross sections, corresponding to the nonstrange particle interactions were evaluated. The obtained relations were tested for the reactions $II^+ P \rightarrow CX$ at 8 GeV/c and $pp \rightarrow CX$ at 12 GeV/c, by C being denoted II^+, II^- or P. (auth)

8105 (KFK-EXT-3-74-1) MEASUREMENT OF THE $\pi\pi$-S-WAVE IN THE REACTION $\pi^-p \rightarrow \pi^0\pi^0n$. Apel, W. D. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Apr 1974. 71p. (In German). Dep. NTIS (US Sales Only) $6.75.

Thesis. Submitted to Univ., Karlsruhe, Ger.

An investigation of the reaction $\pi^-p \rightarrow \pi^0\pi^0n$ (1) at 8 GeV/c incident pion momentum is reported. Directions and energies of all involved particles are measured: the interaction point of the π^- in the liquid hydrogen target is determined from the π^--Cerenkov light, time of flight and impact point of the neutron are measured in a neutron counter array, the 4 decay gammas of the $2\pi^0$ are detected in optical spark chambers. Events of the reaction (1) are selected from the background of other possible processes in an overconstrained kinematical fit. Assuming a one-pion-exchange model modified by form factors $\pi\pi$-scattering: $\pi^+\pi^- \rightarrow \pi^0\pi^0$ in reaction (1) is analyzed, in particular the lowest partial wave, the I = O S-wave. It is shown to be resonant in the region of invariant $\pi\pi$-masses 0.65 GeV/c < $M_{\pi\pi}$ < 0.95 GeV. The existence of a narrow ($\Gamma \lesssim$ 0.15 GeV) S-wave resonance near $M_{\pi\pi} \sim$ 0.75 GeV is excluded. At masses $M_{\pi\pi} \sim$ 1 GeV a rapid rise of the S-wave phase shift and a strong inelasticity is observed, which can be explained by a coupling of the $\pi\pi$-S-wave to the $K\bar{K}$-S-wave. (auth)

8106 (RHEL-72-1(Vol.2), pp 1-25) HIGH ENERGY DIFFERENTIAL CROSS SECTIONS FOR K^0 PRODUCTION. Willen, E. H.; Foley, K. J.; Kramer, M. A.; Love, W. A.; Ozaki, S.; Platner, E. D.; Saulys, A. C.; Lindenbaum, S. J. (Brookhaven National Lab., Upton, NY). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Differential and total cross sections for the reactions $\pi^- + p \rightarrow K^0 + \Lambda$, $\pi^- + p \rightarrow K^0 + \Sigma^0$, $K^- + p \rightarrow \bar{K}^0 + n$, and $K^+ + p \rightarrow K^0 + N^{++}$ at 8 to 15.7 GeV/c are reported. (JFP)

8107 (RHEL-72-1(Vol.2), pp 26-34) HIGH STATISTICS STUDY OF THE REACTION $\pi^-p \rightarrow \pi^-\pi^+n$ AT 17 GeV/c: THE $(\pi^+\pi^-)$ MASS INTERVAL OF THE RHO MESON. Grayer, G.; Hyams, B.; Jones, C. (CERN, Geneva). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

A sample of 318,000 events of the reaction $\pi^-p \rightarrow \pi^-\pi^+n$ at 17.2 GeV/c with 94,000 events in the mass interval of the ρ meson [0.71 < $M(\pi^+\pi^-)$ < 0.83 GeV/c^2] was measured in a spark-chamber experiment. For these latter events the $\pi^+\pi^-$ decay angular distribution parametrized in spherical harmonic moments was studied as a function of t, the four-momentum transfer squared between p and n. At high |t| the ρ is produced in an almost pure t-channel helicity one state with around 80% natural parity exchange. A comparison of the data with the absolute predictions of the simple absorption model parametrization of Williams shows good agreement, but only in the range $-t < 0.06$ (GeV)^2. (auth)

8108 (RHEL-72-1(Vol.2), pp 49-84) SOME RESULTS ON MANY-BODY PROCESSES IN COLLISIONS OF π^+p AT 8 AND 16 GeV/c, π^-p AT 16 GeV/c, AND K^-p AT 10 GeV/c. Aachen-Berlin-Bonn-CERN-Cracow-Heidelberg-London-Vienna-Warsaw Collaboration. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Results on the many-body problem for pion–proton interactions are reviewed including the LPS method, single particle distributions, limiting fragmentation and the generalized optical theorem, and two-particle distributions and correlations. (JFP)

8109 (RHEL-72-1(Vol.2), pp 140-156) SINGLE-PARTICLE AND TWO-PARTICLE INCLUSIVE π+p REACTIONS. Kenney, V. P.; Shephard, W. D.; Biswas, N. N.; Cason, N. M.; Powers, J. T. (Univ. of Notre Dame, IN). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

A review is given of single-particle inclusive reactions $\pi + p \rightarrow \pi^- +$ anything with particular reference to the approach to limiting distributions in the longitudinal momentum variable in the target fragmentation region and the use of inclusive:exclusive reaction comparisons to study the evident excess of events with small values of transverse-momentum squared. Data for the two-particle inclusive reactions $\pi + p \rightarrow 2\pi^- +$ anything are presented, and the correlations between the produced π^- are discussed. (JFP)

8110 (RHEL-72-1(Vol.2), pp 162-173) MULTIPLICITY DISTRIBUTIONS IN π^-p, π^-n, AND π^-C INTERACTIONS AT p = 40 GeV. Bucharest-Budapest-Cracow-Dubna-Hanoi-Serpukhov-Sofia-Tashkent-Tbilisi-Ulan Bator-Warsaw Collaboration. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The results on multiplicity of charged particles produced in π^-p, π^-n and π^-C interactions at the momentum p = 40 GeV/c are presented. The dependence of the average number of γ-quanta on the number of charged particles in π^-p and π^-n collisions is also given. (auth)

8111 (RHEL-72-1(Vol.2), pp 174-179) INELASTIC INTERACTIONS OF 67 GeV/c PROTONS AND 60 GeV/c π^- MESONS WITH PROTONS AND NUCLEI. Dalkhazhav, N.; Khoshmukhamedov, R. A.; Shabratova, G. S.; Tolstov, K. D. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Partial cross sections as a function of total energy and ratios of partial cross sections to total inelastic cross sections are shown for π^- + p and p + p interactions. Also angular distributions of shower particles from π^- + p and π^- reactions with C, O, Ag, and Br are shown. (JFP)

8112 (RHEL-72-1(Vol.2), pp 230-240) ELASTIC SCATTERING OF π^-p, K^-p, AND $\bar{p}p$ AT 25 AND 40 GeV/c. Antipov, Yu. M. (Inst. of High Energy Physics, Serpukhov, USSR); Busnello, R.; Damgaard, G. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The differential cross sections for the elastic diffraction scattering of π^- + p, K^- + p, $\bar{p}$ + p are reported. (JFP)

8113 (RHEL-72-1(Vol.2), pp 241-244) SMALL ANGLE ELASTIC SCATTERING OF π^- ON PROTONS IN THE MOMENTUM RANGE 30 TO 55 GeV/c. Bugorskii, A. P.; Bushnin, U. B.; Derevschikov, A. A. (Inst. of High Energy Physics, Serpukhov, USSR). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The differential cross sections for π^- + p elastic scattering at 30 to 55 GeV/c are shown. (JFP)

8114 (RHEL-72-1(Vol.2), pp 245-250) ASSOCIATED PRODUCTION REACTIONS IN THE RANGE 3.0 TO 6.0 GeV/c INCIDENT BEAM MOMENTA. Yovanovitch, D. D.; Ambats, I.; Lesnik, A.; Meyer, W. T.; Rust, D. R.; Ward, C. E. W. (Argonne National Lab., IL). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Some preliminary results are presented on pion induced neutral final states in the reactions $\pi^- + p \rightarrow K^0 + \Lambda$, $\pi^- + p \rightarrow K^0 + \Sigma^0$, and $\pi^- + p \rightarrow \Lambda^0 + K^0$ (with Λ^0 forward) at 3 to 6 GeV/c. The lambda polarization and differential cross sections are found. (JFP)

8115 (RHEL-72-1(Vol.2), pp 251-256) COMPARISON OF PARTICLE–ANTIPARTICLE ELASTIC SCATTERING FROM

3 TO 6 GeV/c. Yovanovitch, D.; Ambats, I.; Ayres, D. S.; Diebold, R.; Greene, A.; Kramer, S.; Lesnik, A.; Rust, D.; Ward, C.; Wicklund, A. B. (Argonne National Lab., IL). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The elastic differential cross sections were measured for π^- + p, π^+ + p, K^- + p, K^+ + p, p + p, and $\bar{p}$ + p interactions at 3 to 6 GeV/c were measured. The experimental technique is briefly described, and comments are made on the preliminary results. (JFP)

8116 HELICITY CONSERVATION IN PERIPHERAL PRODUCTION OF THE $p\pi^+\pi^-$-SYSTEM IN THE REACTION $\pi^-p \to p\pi^+\pi^-\pi^-$ AT 4.5 GeV/c. Beketov, G. V.; Zombkovskii, S. M.; Kaidalov, A. B.; Konovalov, B. S.; Kruchinin, S. P.; Pozhidaeva, N. A.; Selektor, Ya. M.; Turov, V. F.; Shulyachenko, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 4, 830-838(Apr 1974). (In Russian).

The 50- and 55-cm liquid hydrogen bubble chambers were used to study the helicity conservation in the peripheral production of $p\pi^+\pi^-$ systems in the reaction $\pi^-p \to p\pi^+\pi^-\pi^-$ at 4.5 GeV/c momentum. It is shown that the observed approximate conservation of the t-channel helicity is consistent with the Regge pole exchange model. The cross sections of the production of N*(1500) and N*(1700) isobars in the reaction $\pi^-p \to p\pi^+\pi^-\pi^-$ are determined. They are 42 ± 8 μb for N*(1500) and 40 ± 12 μb for N*(1700). (auth)

8117 4π SYSTEM IN THE ρ'_{1710} MESON MASS REGION IN THE REACTION $\pi^-p \to p\pi^+\pi^-\pi^-\pi^0$ AT 4.5 GeV/c MOMENTUM. Kliger, G. K.; Beketov, G. V.; Grechko, V. E.; Guzhavin, V. M.; Dubovikov, M. S.; Zombkovskii, S. M.; Kolganov, V. Z.; Konovalov, B. S.; Kruchinin, S. P.; Lebedev, A. V.; Lomakatsi, G. S.; Nilov, A. F.; Selektor, Ya. M.; Smolyankin, V. T.; Turov, V. F.; Shulyachenko, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 4, 839-848(Apr 1974). (In Russian).

The liquid-hydrogen chambers were used to study the formation of ρ'_{1710} meson in the reaction $\pi^-p \to p\pi^+\pi^-\pi^-\pi^0$ at 4.5 GeV/c momentum. The experimental distributions are compared with the predictions of the Regge pole exchange model. The analysis of the mass spectra, of the production cross sections and distributions of the reaction products gives the results consistent with the resonance interpretation of the ρ′ maximum. The cross section of the process $\pi^-p \to p\rho' \to p4\pi$ has appeared to be ~34 μb. The probability of the dominant decay $\rho' \to \rho^0\rho^-$ is about 56% of all 4π decays. The possible sets of the ρ′ quantum numbers are determined to be $J^P = 3^-, 5^-$ etc and $J^P = 2^-, 4^-$ etc. (auth)

8118 INTERFERENT MEASUREMENTS OF THE REAL PART OF THE FORWARD π^-p ELASTIC SCATTERING AMPLITUDE AT 2.44 AND 1.91 GeV/c MOMENTUM. Vorob'ev, G. G.; Govorun, N. N.; Nomofilov, A. A.; Ivanchenko, I. M.; Kirilov, S. S.; Lyaiste, R.; Piskunov, N. M.; Sitnik, I. M.; Strokovskii, E. A.; Strunov, L. N.; Sharov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 4, 849-860(Apr 1974). (In Russian).

The real part of the hadronic amplitude of the forward π^-p elastic scattering is measured at 2.44 and 1.91 GeV/c momenta. The measurements were made using the method of detecting the scattered particles by means of the wire spark chambers in the region $0.5 \cdot 10^{-3} \leq |t| \leq 5 \cdot 10^{-3}$ (GeV/c)^2. The obtained results which insignificantly differ from the preliminary data reported earlier, are compared with the theoretical predictions. The experimental procedure and the method of the data processing are described in detail. (auth)

8119 SPIN PARITY STRUCTURE OF THE Q AND L ENHANCEMENTS IN $K^-p \to (K^-\pi^-\pi^+)p$ AT 10 AND 16 GeV/c. Deutschmann, M.; Otter, G.; Rudolph, G. (Institut der Technischen, Aachen, Ger.). Phys. Lett.; 49B: No. 4, 388-392(29 Apr 1974).

A partial wave analysis of the (Kππ) system produced in $K^-p \to (K^-\pi^-\pi^+)p$ at 10 and 16 GeV/c was performed. It is found that in 88% of the cases the (Kππ) system is in unnatural spin-parity (J^P) states $0^-, 1^+, 2^-\ldots$, with contributions from many decay modes, κπ, K*(890)π, K*(1420)π, Kε, Kρ and Kf. More than one decay mode and J^P state are required to describe the Q and L enhancements, suggesting a composite structure of these enhancements. The (Kππ) system is produced dominantly (~95%) by natural parity exchange. Overall, the production mechanism of the (Kππ) system is remarkably similar to that of the 3π system in $\pi^-p \to (\pi^-\pi^-\pi^+)p$, even in the detailed spin-parity structure. (auth)

8120 FINAL RESULTS OF A MEASUREMENT OF A_{nn} FROM THE REACTION $\pi^-d \to 2n\gamma$. Salter, R. M. (Univ. of California, Los Angeles); Zeller, M.; Haddock, R. P.; Nygren, D.; Czirr, J. B. pp 112-113 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A reliable measurement of the neutron–neutron S-wave scattering length is of great interest in determining the exact role of direct and indirect electromagnetic effects in breaking strong interaction symmetries. As free neutron–neutron scattering events are not available in useful quantities, knowledge of a_{nn} comes mainly from final-state interactions involving two, and generally more, nucleons. The reaction $\pi^-d \to 2n\gamma$ is unique in that all three final-state particles are easily detected, but only the two neutrons are strongly interacting. This greatly increases the ability to perform precise experiments which are interpretable by reliable theoretical calculations. An experiment at the LBL 184 in. Synchrocyclotron in which all three final-state particles were detected and the energy of the neutrons measured by time-of-flight techniques is reported. This allowed a three-constraint fit to the hypothesis of $\pi^-d \to 2n\gamma$ with a reconstructed photon energy resolution of better than 50 keV or 0.05%. A preliminary analysis of the data gave a value of $a_{nn} = -16.4 \pm 1.9$ F, based on the neutron time-of-flight spectra. (auth)

8121 PRELIMINARY SEARCH FOR THE X^0 (958) MESON. Upadhyay, P. N. (Gaya Coll., Bihar, India). Indian J. Pure Appl. Phys.; 11: No. 10, 716-719(Oct 1973).

A neutral enhancement produced in the interaction $\pi^-p \to X^0 n$ near threshold over a range of four-momentum transfer in the region from −0.38 to −0.79 (GeV/c)^2 was observed at mass 956 ± 2 MeV/c^2 with width ≤12 MeV/c^2 in a missing mass counter experiment. The missing mass of the X^0 was calculated by measuring pion momentum in the initial state and the neutron time-of-flight. (auth)

8122 MEASUREMENT OF THE $\pi^-p \to n\pi^0$ AND $\pi^-p \to n\gamma$ DIFFERENTIAL CROSS SECTIONS NEAR THE RESONANCE P_{11} (1460). Cheze, J. B.; Codreanu, N.; Hamel, J. L.; Le Calvez, O. L.; Teiger, J.; Thevenet, B.; Zaccone, H.; Asembrey, J. (CEN, Saclay, France). Nucl. Phys.; B72: No. 3, 365-375(1974).

The $\pi^-p \to n\gamma$ and $\pi^-p \to n\pi^0$ differential cross sections were measured for $-0.9 < \cos\theta^* < -0.45$ (θ^* c.m. scattering angle) at 475 MeV/c and 550 MeV/c incident momenta. The $\pi^-p \to n\gamma$ measurement is a good check of the detailed balance principle in the electromagnetic interactions of hadrons at these energies and is in good agreement with Walker's analysis. On the other hand the $\pi^-p \to \pi^0 n$ extrapolated values at 180° allows one to verify that the phases of the $A_{1/2}$ and $A_{3/2}$ amplitudes are equal. (auth)

8123 DIFFERENTIAL $K_L \to K_S$ REGENERATION CROSS SECTION IN COHERENT PRODUCTION MODEL AND OPTICAL MODEL. Wang, W. L.; Uchiyama, F. (Univ. of California, Berkeley). Nucl. Phys.; B73: No. 1, 23-39(1974).

The high-energy $K_L \to K_S$ regeneration process is investigated in nuclei in terms of a coherent production model. The angular distribution of the regenerated K_S is calculated for Pb and Cu at an incident momentum of 4 GeV/c. The experimental data are well reproduced. An optical-model calculation was also performed which explicitly treats K_L as a mixture of K_0 and $\overline{K_0}$ particles. It is shown that it is not necessary to introduce a large neutron skin in the above nuclei to interpret the data, if the finite range of strong interaction is taken into account properly in the density distribution. The coherent production model and the optical model, with seemingly very different physical interpretations, give very similar results. It is also shown that these models represent two ways of summing the multiple scattering series in the particular case of $K_L \to K_S$ regeneration. In conclusion, the unique and important feature of using nuclear regeneration scattering to study scattering theories, as compared to other high-energy particle-nucleus scattering is discussed. (auth)

8124 REACTION $K^- + p \to \Sigma^0 + \eta$ THRESHOLD. Jones, M. D. (Univ. of Chicago). Nucl. Phys.; B73: No. 1, 141-165(1974).

The reaction $K^- + p \to \Sigma^0 + \eta$ was studied using data from a 600,000 picture exposure at nine K^- momenta from 862–1001 MeV/c in the Lawrence Berkeley Laboratory 25 in. liquid hydrogen bubble chamber. Cross sections were obtained using both events where the η decayed via neutrals and events where the η decayed into $\pi^+\pi^-\pi^0$. Angular distributions were obtained from only those events where the η decayed into $\pi^+\pi^-\pi^0$. The results are compared to previous analyses and the questions of the Ση decay rate and SU(3) classification of the $1/2^-$ Σ(1750) are discussed. (auth)

8125 MEASURING THE DELTA-TERM IN PION–NUCLEON SCATTERING. Altarelli, G. (Univ., Rome). pp 253-263 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

The sigma term in pion–nucleon scattering is evaluated by relating its magnitude to the values of various low energy parameters of the on-shell $\pi + N$ amplitude. (JFP)

8126 PION DIFFRACTION DISSOCIATION IN 205-GeV/c $\pi^- p$ INTERACTIONS. Winkelmann, F.C.; Abrams, G.S.; Bingham, H.H.; Chew, D.M.; Daugéras, B.Y.; Fretter, W.B.; Friedberg, C.E.; Goldhaber, G.; Graves, W.R.; Johnson, A.D.; Kadyk, J.A.; Stutte, L.; Trilling, G.H.; Yost, G.P. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Bogert, D.; Hanft, R.; Huson, F.R.; Ljung, D.; Pascaud, C.; Pruss, S.; Smart, W.M. Phys. Rev. Lett. 32: No. 3, 121-125 (21 Jan 1974).

Pion diffraction dissociation into masses up to approximately 6 GeV is observed in the reaction $\pi^- + p \to p + X$ at 205 GeV/c. The pion single-diffraction cross section for mass squared ≤ 32 GeV^2 is 1.9 ± 0.2 mb. (auth)

8127 SEARCH FOR NEUTRAL MESONS NEAR 1 GeV/c^2. Binnie, D.M.; Camilleri, L.; Carr, J.; Debenham, N.C.; Duane, A.; Garbutt, D.A.; Jones, W.G.; Keyne, J.; Soitis, I. (Department of Physics, Imperial College, London SW7 2BZ, United Kingdom); McEwen, J.G. Phys. Rev. Lett. 32: No. 7, 392-395 (18 Feb 1974).

In a study of the missing-mass spectrum near 1 GeV in the reaction $\pi^- + p \to MM + n$ at three incident momenta near 2 GeV, we find no evidence for the recently reported narrow neutral mesons at 940, 963, and 1033 MeV. (auth)

8128 NEW UPPER LIMIT ON THE WIDTH OF THE $X^0(958)$. Duane, A.; Binnie, D.M.; Camilleri, L.; Carr, J.; Debenham, N.C.; Garbutt, D.A.; Jones, W.G.; Keyne, J.; Siotis, I. (Physics Department Imperial College, London, England); McEwen, J.G. Phys. Rev. Lett. 32: No. 8, 425-428 (25 Feb 1974).

An upper limit $\Gamma_{X0} < 0.8$ MeV/c^2 (95% confidence level) is deduced from the missing-mass spectrum near 958 MeV/c^2 in the reaction $\pi^- + p \to MM + n$ close to threshold. Measurement of those missing masses which decay to 2γ shows at single peak with a central mass of 957.4 $\pm$ 0.5 MeV/c^2 close to the value of 957.46 $\pm$ 0.33 MeV/c^2 deduced from the total missing-mass spectrum. (auth)

8129 EVIDENCE FOR THE $\omega\pi\pi$ DECAY MODES OF THE A_2 AND ω (1675). Díaz, J.; DiBianca, F.A.; Fickinger, W.J.; Malko, J.S.; Robinson, D.K.; Sullivan, C.R. (Case Western Reserve University, Cleveland, Ohio 44106); Anderson, J.C.; Engler, A.; Kraemer, R.W.; Toaff, S.; Weisser, F. Phys. Rev. Lett. 32: No. 5, 260-264 (4 Feb. 1974)

We present evidence for the decay $A_2^0 \to \omega\pi^+\pi^-$ with a branching ratio $\Gamma(A_2 \to \omega\pi\pi)/\Gamma(A_2 \to p\pi) = 0.28 \pm 0.09$ and for the decay $\omega(1675) \to \omega\pi^+\pi^-$ with a branching ratio $\Gamma(\omega(1675) \to \omega\pi^+\pi^-)/\Gamma(\omega(1675) \to g\bar{\pi}) = 0.47 \pm 0.18$. Evidence is given for an intermediate B(1235) π state in the ω (1675) decay. (auth)

8130 ENERGY DEPENDENCE OF BACKWARD $\pi^+ p$ ELASTIC SCATTERING FROM 2 TO 6 GeV/c. Baker, W.F.; Eartly, D.P.; Pretzl, K.P.; Pruss, S.M.; Wehmann, A.A. (National Accelerator Laboratory, Batavia, Illinois 60185); Koehler, P.; Lennox, A.J.; Poirier, J.A.; Rey, C.A.; Sander, O.R. Phys. Rev. Lett. 32: No. 5, 251-253 (4 Feb 1974).

The energy dependence of backward $\pi^+ p$ elastic scattering has been measured for incident π momenta 2.0–6.0 GeV/c in steps of typically 100 MeV/c. Values are presented for both the differential cross section extrapolated to 180° and the slope of the backward peak as a function of momentum. In the s channel we see the effects of the establish Δ^{++} resonances and evidence for the $\Delta(3230)$. Also, the data show the existence of a negative-parity Δ resonance with mass ~2200 MeV/c^2. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 8047.

8131 (FAI-10) SOME REMARKS ON RELATIVISTICALLY INVARIANT EQUATIONS. Loide, R. K. (AN Ehstonskoj SSR, Tartu. Inst. Fiziki i Astronomii). 1972. 19p. INIS.

Relativistically invariant equations of random order for particles with nonzero mass were examined. The matrices $\beta_{\mu_1 \ldots \mu_r}$ were expressed by spin projection operators. The connection of some specific equations with the general equations was examined. It was indicated that in the equations of Weinberg, Pose, and Tang only one spin is distinguished but the second-order Hua equation in general describes several particles. Some remarks are made on the interpretation of the representations of the Poincare groups. (tr-auth)

8132 (HU-TFT-72-20) NEW VARIABLES FOR THE STUDY OF TRANSVERSE MOMENTUM CORRELATIONS IN MULTI-PARTICLE PROCESS. Korkea-aho, M.; Nyborg, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Aug 1972. 22p. INIS.

A new set of transverse momentum variables is introduced in the description of two-particle inclusive reactions, giving an alternative approach to the study of correlations in transverse momenta. (auth)

8133 (JEN–256) REVIEW OF THE HELICITY FORMALISM. Barreiro, F.; Cerrada, M.; Fernandez, E. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 73p. (In Spanish). INIS.

A brief and general review of the helicity formalism is given. Lorentz invariance, spin and helicity ideas, the construction of relativistic states and scattering amplitudes in the helicity basis and their transformation properties under discrete symmetries, and finally some more sophisticated topics like kinematical singularities of helicity amplitudes, kinematical constraints and crossing relations, respectively, are presented. (auth)

8134 (JINR-P2-7852) CLASSICAL DYNAMICS OF THE RELATIVISTIC STRING. Barbashov, B. M.; Chernikov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 32p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

A method developed earlier for solving the nonlinear equations for a system of fields of the Born-Infeld type is applied for solving the equations of motion of a relativistic string which are interpreted as equations of the plateau problem in $n + 1$ – dimensional pseudo-euclidean space. The general Cauchy problem is solved in the dynamics of the relativistic string, i.e. there is found the integral surface (the world sheet of the string), which passes through a given initial space-like curve (an initial configuration of the string) and is tangent to a field of vectors (initial velocities of the string). Solutions for different parametrizations of the initial curve are presented and examples of motion for various initial configurations and velocities of the string are considered. In particular, a motion is investigated of the string rolled up at the initial time into a ring or spiral. For these cases the forces are found which are connected with elasticity of this string. For some other initial configurations and velocities, the string does not reveal the elasticity properties and behaves as a one-dimensional manifold of nonconnected points. A relativistic expression is given for a momentum and rest mass of an element of the string. For the closed string (loop) an expression is written for a total momentum P and total rest mass M of the string as a whole. The total rest mass $M = \sqrt{-P^2}$ as well as the total momentum is conserved but the masses of elements of the string dm are changing in the process of motion. These quantities are calculated for the closed string (a loop). (auth)

8135 (RHEL-72-1(Vol.2), pp 303-326) FRAGMENTATION MODELS FOR PARTICLE PRODUCTION. Berger, E. L. (Argonne National Lab., IL). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Four papers on models for diffractive fragmentation are discussed. By fragmentation is implied a collision picture in which an incident hadron is excited into a state of mass M, the state M subsequently decaying to a ground state by emission of π's, K's, $\bar{p}$'s, etc. (JFP)

8136 (RHEL-72-1(Vol.2), pp 379-398) MULTIPLICITY DISTRIBUTIONS AND INTEGRATED MOMENTUM DISTRIBUTION FUNCTIONS IN HIGH ENERGY HADRON PRODUCTION PROCESSES. Koba, Z.; Nielsen, H. B.; Olesen, P. (Univ. of Copenhagen). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The generating function formalism is applied to an empirical formula of Czyzewski and Pybicki on the multiplicity distribution in hadronic production processes below 30 GeV. Integrals of a few particle momentum distribution and correlation functions are evaluated, and importance of testing the validity of empirical regularity $\langle n \rangle / D \approx$ const. and/or the behavior of correlation integrals at higher energies is emphasized. (auth)

8137 (RHEL-72-1(Vol.2), pp 443-450) LIMITING BEHAVIOR OF PARTIALLY INCLUSIVE REACTIONS. Satz, H. (Univ., Bielefeld, Ger.). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The limiting behavior of partially inclusive reactions, defined by a restricted summation over undetected final states, is investigated. Their behavior is shown to provide a tool for testing the dynamical basis of scaling in inclusive processes. (auth)

8138 WHAT MEASUREMENTS ARE INTERESTING FOR THE MULTIPERIPHERAL MODEL WITH A CONSTANT TOTAL CROSS SECTION? Levin, E. M.; Ryskin, M. G. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 19: No. 4, 904-920(Apr 1974). (In Russian).

Some qualitative experimental consequences of the multiperipheral approach connected with main features of multiperipheral models in which the cross section is constant at high energy are considered in detail. The consequences are the following: the experimental predictions for resonance production cross section and the transverse momentum distribution of resonances, charge and spin correlations connected with existence of resonances, energy dependence of the mean multiplicity. (auth)

8139 PARTICLE CREATION FROM VACUUM BY HOMOGENEOUS ELECTRIC FIELD WITH A PERIODICAL TIME DEPENDENCE. Mostepanenko, V. M.; Frolov, V. M. (Leningrad State Univ.). Yadern. Fiz.; 19: No. 4, 885-896(Apr 1974). (In Russian).

Fermion and boson pair creation from vacuum by the homogeneous electric field with a periodical time dependence is considered. The character of dependence of the created particle number on the time period τ, while its external field is engaged, is determined. It is shown that the density of the created fermions depends on τ periodically. The conclusion is obtained that the density of created bosons with some fixed momenta increases with τ as $e^{\epsilon\tau}$ where $\epsilon > 0$. (auth)

8140 WHAT IS AN ELEMENTARY PARTICLE? Weisskopf, V. F. (Massachusetts Inst. of Tech., Cambridge). pp 274-298 of Physics 50 Years Later. Brown, S. C. (ed.). Washington, DC; National Academy of Sciences (1973).

The historical development of the analysis of the structure of matter is reviewed including the chemical, nuclear, and particle structure. The various theories of particle structure are discussed. (JFP)

8141 MULTIPLICITY DISTRIBUTION IN IMPACT-PARAMETER SPACE AND INCLUSIVE OVERLAP FUNCTIONS. Sakai, N. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Nuovo Cim.; 21A: No. 2, 368-386(21 May 1974).

Inclusive overlap functions are defined which carry complete information on multiplicity distributions at incident impact parameter b. Mueller's optical theorem is generalized to a nonforward unitarity relation which gives the inclusive overlap function in terms of the many-body elastic amplitude. The assumption of a simple factorizable pomeron pole gives the average multiplicity $\bar{n}(b)$ and higher binomial moments at impact parameter b in terms of the two-pomeron–two-particle coupling c(t), which is the Fourier transform of the step distribution of the random walk in the multiperipheral model. The natural assumption of a decreasing c(t) for $t < 0$ gives an increasing $\bar{n}(b)$. (auth)

8142 SYSTEMATICAL MULTIPARTICLE THEORY AND ITS APPLICATION TO THE FOUR-NUCLEON PROBLEM. Alt, E. O.; Grassberger, P.; Sandhas, W. (Univ., Mainz). pp 299-303 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

In the last years some effort was made to extend the Faddeev theory to the general n-body case. Starting from a consideration of the common structure of the 2- and 3-body equations it is shown that the generalization to n particles can be accomplished in a more natural way. It is a characteristic feature of this approach that the kernel of the occurring integral equations is built up by all subsystem transition operators in an explicit way. I.e., one of the most important features of the 3-body theory is also achieved in this n-body formalism. This enables one to apply in a very direct way the quasiparticle concept, reproducing thereby a previously given approach. (auth)

8143 STOCHASTIC MODEL FOR THE MULTIPLE GENERATION OF HADRONS. Potupa, A. S. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR; 18: No. 4, 311-313(Apr 1974). (In Russian).

The equivalence of the equation of the stochastic Poisson process and the multiperipheral model of the de Tar type was shown. The simplest generalization on the pure multiplication yields the Poe distribution on multiplicity. Some types of generating particles were discussed on the basis of the breakdown of the regularity of the process (bursts). (tr-auth)

8144 DEVELOPMENTS IN HIGH-ENERGY PHYSICS. Proceedings of the International School of Physics, Enrico Fermi, Course LIV, Varenna, Italy, August 2–14, 1971. Gatto, R. (ed.). New York; Academic Press, Inc. (1972). 440p. (CONF-710858-). $34.50.

The conference included 20 papers. Separate abstracts were prepared for each paper. (JFP)

For abstracts of individual papers see: 7583, 8063, 8091, 8125, 8145–8148, 8178, 8179, 8217, 8246, 8255–8257, 8262, 8270, 8286, 8608, and 8609.

8145 MULTIPERIPHERAL MODELS AND HIGH ENERGY PROCESSES. Goldberger, M. L. (Princeton Univ., NJ). Contract AT(30-1)-4159. pp 1-57 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

The lectures on multiperipheral models cover the ABFST model, variational principle for ABFST equations, and triple-pomeron vertex and diffractive dissociation. (JFP)

8146 PHYSICAL STATES IN THE DUAL-RESONANCE MODEL. Brower, R. C. (Massachusetts Inst. of Tech., Cambridge); Goddard, P. pp 98-110 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

The formalism of the dual resonance model is reviewed in the case of unit intercept. Then a recent extension of this formalism to vertices for the coupling of physical excited states is described. An account is given of a very recent attempt to extend this into a spectrum generating algebra which produces all the physical states for $\alpha(0) = 1$. (JFP)

8147 CONSERVATION LAWS IN INCLUSIVE REACTIONS. Venezino, G. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. pp 117-129 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

A discussion is given of some of the consequences of conservation of energy momentum (or of any other additive quantum number) on inclusive cross sections. An attempt is made to show that conservation laws yield very nontrivial results in inclusive processes. Both phenomenological and theoretical results are considered. (JFP)

8148 SCALING ANOMALIES. Coleman, S. (Harvard Univ., Cambridge, MA). pp 280-296 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

A study is made of how well the theory of broken scale invariance agrees with renormalized perturbation theory. The difficulties with the Ward identities are discussed. (JFP)

8149 STRENGTHS OF STRONG AND OTHER INTERACTIONS. Freund, P.G.O.; Nandi, S. (The Enrico Fermi Institute and the Department of Physics, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. Lett. 32: No. 4, 181-184 (28 Jan 1974).

The requirement of compatibility of vector-meson dominance and partial conservation of axial-vector current in $\pi^0 \to 2\gamma$ decay [along with $SU(6)_W$ symmetry] determines the absolute value of the $\rho\pi\pi$ coupling constant. The strength of strong interactions results inversely proportional to the number of postulated quarks. In dynamical models of spontaneous symmetry breaking the electromagnetic, weak, and gravitational interactions are found also to have strengths inversely proportional to the corresponding numbers of fundamental fermions. (auth)

Electromagnetic

8150 (DESY-74-7) ELECTROMAGNETIC PROPERTIES OF HADRONS IN A RELATIVISTIC QUARK MODEL. Boehm, M.; Joos, H.; Krammer, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Mar 1974. 10p. (CONF-740332-1). Dep. NTIS (US Sales Only) $4.00.

From 9th Rencontre de Moriond conference; Meribel-les-Allues, France (3 Mar 1974).

Results from a relativistic dynamical quark model are presented for: the vector-meson-photon coupling constants for ordinary and heavy vector mesons; the total e^+e^- annihilation into hadrons; the pion form factor in the space- and time-like region. (auth)

8151 (DESY-74-13) CHARGED PARTICLE FLUCTUATIONS IN E^+E^- COLLISIONS. Walsh, T. F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Apr 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

There are certain quantities involving charged particles produced in $e^+ e^-$ collisions which average to zero, but whose average square can serve as a probe for the dynamics. One of these is the mean square charge in one hemisphere of $e^+ e^-$ annihilation. It is suggested studying additionally the mean square asymmetry in the distribution of charged particles between two appropriately chosen hemispheres. (auth)

8152 (JINR-P3-7745) NEUTRON-ELECTRON INTERACTION MEASUREMENT BY THE METHOD OF SLOW NEUTRON DIFFRACTION ON SINGLE CRYSTALS OF TUNGSTEN-186. Aleksandrov, Yu. A.; Machekhina, T. A.; Sedlakova, L. N.; Fykin, L. E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Neutron-diffraction investigations are carried out for single crystals from two isotope mixtures of tungsten enriched by ^{186}W isotope and having the contrary in sign amplitude of coherent scattering. It is shown that the theoretical description of the results is possible when introducing the hypothesis about an additional scattering contributing into the Bragg peaks. (auth)

8153 (N-73-27610) RELATIVISTIC DYNAMICS OF A POINT CHARGE IN THE FIELD OF A PLANE ELECTROMAGNETIC WAVE TRAVELING IN THE DIRECTION OF A UNIFORM STATIC MAGNETIC FIELD. Mitchell, T. P. (California Univ., Santa Barbara (USA). Dept. of Mechanical Engineering). Jun 1973. 18p. (NASA-CR-132781). NTIS $3.00.

The motion of a charged particle in electromagnetic fields of various geometric configurations and arising from a variety of sources is of intrinsic interest in electromagnetic theory. The particular configuration consisting of a plane wave propagating in the presence of a static uniform magnetic field whose direction is parallel to the wave normal is examined. The analysis presented is treated within the context of classical electromagnetic theory. A numerical solution—at least to the approximate Lorentz-Dirac equation—is obtained. (auth)

8154 (RHEL-72-1(Vol.2), pp 293-302) RECENT APPLICATIONS OF THE COVARIANT PARTON MODEL. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ., Eng.). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The covariant formulation of the dual quark parton model has produced a theory which is in reasonable quantitative agreement with experiment for inclusive deep inelastic scattering. Recent extensions of the theory include: analysis of heavy muon-pair production, including large angle events; elucidation of the fixed pole structure of Compton scattering, with consequences for pomeron coupling and deep inelastic sum rules; an investigation of the (model dependent) predictions for exclusive single particle production in the Bjorken limit; applications to purely hadronic processes, with particular reference to the additive quark model and s-channel helicity conservation. (auth)

8155 (RL-73-100) GAUGE MODELS WITHOUT CHARMED HADRONS. Ross, G. G.; Zia, R. K. P. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Mar 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

The possibilities for constructing unified gauge models of the weak and electromagnetic interactions without charmed hadrons are investigated. Methods for suppressing both direct and induced strangeness changing neutral currents are suggested, and their experimental consequences are considered. (auth)

8156 IMPOSSIBILITY OF REDUCTION OF GENERALIZED ELECTROMAGNETIC FIELDS FOR NONZERO MASS SYSTEM IN FREE SPACE. Rajput, B. S.; Prakash, O. (Kurukshetra Univ., India). Indian J. Phys.; 47: No. 11, 641-649(Nov 1973).

Symmetrical reduced expansions of electric and magnetic fields are derived in the presence of electric charges and Dirac's monopoles in terms of irreducible representations of proper, orthochronous, inhomogeneous Lorentz group for nonzero mass system. Maxwell's field equations are modified by considering the generalized charge as a complex quantity with electric and magnetic fundamental charges as its real and imaginary parts. The constancy condition for the ratio of electric and magnetic charges on a particle was imposed for explaining the results obtained by the requirement that generalized electromagnetic fields satisfy generalized field equations. Considering the reduced expansions in the absence of electric or magnetic charge source, it was proved that the derivation of reduced expansions for electromagnetic fields satisfying the field equations without sources is not possible for nonzero mass system. (auth)

8157 DIRECT SIMULATION OF INELASTIC ELECTRON SCATTERING. Golovyashkina, L. V.; Nakhodkin, N. G. Vychisl. Sist.; No. 52, 5-20(1972). (In Russian).

By the use of an example of the study of the characteristics of the inelastic scattering of medium energy electrons on thin layers of Be, Al, and Pb, the possibilities of special methods based on the direct simulation by Monte-Carlo methods and the use of tabular calculation methods were illustrated. The good agreement of many calculated characteristics with known literature data was shown. This confirms the accuracy of the method and makes it possible to refer to those results for which there is no direct experimental nor calculated data. (tr-auth)

8158 GAUGE THEORIES AND NEUTRAL CURRENTS. Beg, M. A. B. (Rockefeller Univ., New York). Phys. Lett.; 49B: No. 4, 361-364(29 Apr 1974).

Neutral current effects in some gauge theoretic models of weak and electromagnetic interactions are considered. Asymptotic invariance under the gauge group is proposed and used for estimating deep-inelastic cross sections. The analysis underlines the need for a systematic search for hadronic threshold effects in the coupling of neutral currents. (auth)

8159 FLUCTUATIONS OF ANGULAR DISTRIBUTIONS OF ELECTRONS IN ELECTROMAGNETIC CASCADES IN THE AXIS APPROXIMATION. Bakhtadze, A. K.; Gerasimova, N. M. (Moscow State Univ.). Yadern. Fiz.; 19: No. 4, 878-884(Apr 1974). (In Russian).

An analytic expression is obtained for the dispersion of the electron angular distribution in the small-angle approach to the cascade theory of the electron-photon showers. (auth)

8160 POSSIBLE TEST FOR NEUTRAL CURRENTS. Bilen'kii, S. M.; Dadayan, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 4, 901-903(Apr 1974). (In Russian).

A possible method to study neutral currents predicted by theories of weak and electromagnetic interactions is discussed. The method consists of studying the excitation of the giant dipole resonance by neutrino and antineutrino beam from meson factories. The lower limit of the cross section of such processes is estimated for a number of nuclei. (auth)

8161 MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS WITH KONOPINSKII-MACHMUD LEPTONS. Asratyan, A. E. (Inst. of Physical Research, Erevan). Yadern. Fiz.; 19: No. 4, 897-900(Apr 1974). (In Russian).

The model of weak and electromagnetic interactions attributed to the type of models with spontaneous symmetry breaking is considered. Except for general leptons considered in the Konopinsky-Machmud model, the charged heavy leptons and only one neutral heavy lepton are introduced. The model predicts the existence of processes with nonconservation of the muon (electron) leptonic number. (auth)

8162 PHOTON SPLITTING INTO TWO PHOTONS IN A COULOMB FIELD. Baier, V. N.; Fadin, V. S.; Katkov, V. M.; Kuraev, E. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). Phys. Lett.; 49B: No. 4, 385-387(29 Apr 1974).

Photon splitting in a Coulomb field cross section has been found and compared with recent DESY experiment. The theoretical cross section is approximately two order of magnitude lower than experimental one. A possible origin of the discrepance is discussed. (auth)

8163 EXCLUSIVE ELECTROPRODUCTION IN A MASSIVE QUARK MODEL: PRODUCTION OF VECTOR MESONS. Preparata, G. (Univ., Rome). Phys. Lett.; 49B: No. 4, 374-376 (29 Apr 1974).

The problem of exclusive electroproduction is discussed in the framework of a massive quark model (MQM). An interesting scaling law for the production of vector mesons is derived and compared with experiments. (auth)

8164 NUCLEON ELECTROMAGNETIC POLARIZABILITIES. Bernabeu, J.; Ericson, T. E. O.; Ferro Fontan, C. (CERN, Geneva). Phys. Lett.; 49B: No. 4, 381-384(29 Apr 1974).

Dispersive values for the electric and magnetic polarizabilities of the nucleon are derived neglecting the annihilation channel. It is shown that the intrinsic polarizabilities give major contributions to the susceptibility of nuclei and neutron stars. Better experimental determination of the polarizabilities is consequently badly needed. (auth)

8165 T-MATRIX FORMULA FOR MULTICHANNEL COULOMB SCATTERING. Prugovecki, E. (C.N.R.S., Marseille). Phys. Lett.; 49B: No. 4, 305-307(29 Apr 1974).

It is pointed out that in scattering theory for Coulomb like forces the conventional expression for the off-energy-shell T-matrix does not lead to the correct on-energy-shell T-matrix. An alternative expression giving the correct on-energy shell limit is discussed. (auth)

8166 WHERE ARE THE FRAGMENTS OF THE VIRTUAL PHOTON. Gonzalez, M. A. (Univ. Washington, Seattle); Weis, J. H. Phys. Lett.; 49B: No. 4, 351-355(29 Apr 1974).

The inclusive cross section for the production of a single hadron in deep inelastic electroproduction is studied in a dual resonance model. The Bjorken scaling behavior in the virtual photon fragmentation region for finite $x(= 2p_L^{c.m.}/\sqrt{s})$ is $(1/\sigma^{T,L})d^3\sigma^{T,L}/E^{-1}d^3p \sim (1/q^2)F(x,p_T^2/q^2)$ and thus the transverse momentum grows like q^2, whereas in the parton model $(1/\sigma^{T,L})d^3\sigma^{T,L}/E^{-1}d^3p \sim F(x,p_T^2)$. A related effect is the absence of two-jet structure in e^+e^- annihilation. It is believed that dual model results may give a more reliable indication of the deep inelastic behavior for composite hadrons than the parton model. (auth)

8167 PARTIAL-WAVE ANALYSIS FOR PROTON COMPTON SCATTERING IN THE Δ(1232) ENERGY REGION. Pfeil, W.; Rollnik, H.; Stankowski, S. (Univ., Bonn). Nucl. Phys.; B73: No. 1, 166-188(1974).

Based on the nowadays available phenomenological multipoles for pion photoproduction, a systematic dispersion theoretic calculation of Compton partial amplitudes has been performed. By comparing with the new experimental data in the Δ(1232) region it is found that the hitherto existing discrepancies between the data and theory remain. Our results allow us to isolate the basis of this problem. It is due to the fact that the imaginary parts of the Compton amplitudes determined already by unitarity give too large contributions to the cross section thus leaving no space for real parts required by the dispersion integrals. Therefore a simultaneous partial-wave analysis for Compton scattering and pion photoproduction was carried through employing only the unitarity connections between both. The resulting amplitudes give a good fit to the Compton cross section and all photoproduction data; moreover the photoproduction multipoles agree essentially with those of the previous analyses. On the other hand for Compton scattering, phenomenological amplitudes are obtained for the first time and a model independent test of dispersion theoretic amplitudes can be carried out. For the resonating f_{1M}^{1+} amplitude which describes the M1 excitation and deexcitation to the Δ-isobar, large discrepancies have been found. Possible consequences especially for the forward scattering amplitude and the validity of the Kramers–Kronig relation are discussed. (auth)

8168 SOME ASPECTS OF THE QUARK PARTON MODEL. McElhaney, R. (Univ. of Wisconsin, Madison); Tuan, S. F. Nucl. Phys.; B72: No. 3, 487-501(1974).

A modified Kuti-Weisskopf model which satisfies the Feynman threshold constraints is considered further. Detailed predictions for the sum of neutrino and anti-neutrino differential cross sections on nucleon (which can be readily compared with forthcoming NAL data), the shapes of the structure functions $f_1^{\nu p}$ $^{\nu n}$ and the ratio $f_2^{\nu p}/f_2^{\nu n}$, and spin-dependence of inelastic electron-nucleon scattering versus scaling variable x are delineated. The general features of the model are compared in some detail with the "model independent" approach of Feynman for quark parton theory. (auth)

8169 EFFECT OF RADIATION BREMSSTRAHLUNG ON THE SPECTRAL-ANGULAR CHARACTERISTICS OF SYNCHROTRON RADIATION. Kul'kin, A. G.; Pavlenko, Yu. G.; Voloshchenko, A. M. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 25-30(1974). (In Russian).

Expressions are obtained for the flow, spectral and angular distribution of radiative power, and angular distribution of radiative energy of the two main components of polarization. Changes in charge trajectory caused by radiation bremsstrahlung are taken into account. (tr-auth)

8170 RADIATION FROM ELECTRONS IN A UNDULATOR. Bagrov, V. G.; Sokolov, A. A.; Ternov, I. M.; Fedosov, N. I.; Khalilov, V. R. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 49-52(1974). (In Russian).

Radiation from an electron moving in an undulator of finite length is considered. The polarization and radiative spectrum are investigated. (tr-auth)

8171 ANALOGIES BETWEEN THE RESPONSES OF AN OSCILLATOR AND A DISPERSIVE MEDIUM TO THE FIELDS OF A MOVING POINT CHARGE. de Vooght, J. G. (Univ., Liege). Ann. Phys. (N. Y.); 78: No. 2, 453-466(Jun 1973).

It is shown how the essential features of the perturbations created in a dispersive medium by an external charge (namely screening, excitation, and their respective behavior in different velocity ranges), can be seen to have their origin in the ordinary response of one single oscillator to the fields of a moving point charge. (auth)

8172 POLARIZATION INDICATRICES OF SYNCHROTRON RADIATION. Bagrov, V. G.; Bordovitsyn, V. A.; Kopytov, G. F.; Epp, V. Ya. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 46-49(1974). (In Russian).

The structure of the instantaneous angular distribution of polarization components of synchronous radiation are studied at different choices of the direction of the polarization vector. The directions of the external magnetic field, the direction of the instantaneous velocity of the charge and the direction of the instantaneous acceleration of the charge are varied. (SJR)

8173 CONTRIBUTION TO SIXTH-ORDER ELECTRON AND MUON ANOMALIES. III. Barbieri, R. (Scuola Normale Superiore, Pisa, Italy); Caffo, M.; Remiddi, E. Lett. Nuovo Cim.; 9: No. 17, 690-692(27 Apr 1974).

An analytic evaluation of a contribution to sixth-order electron and muon magnetic-moment anomalies is presented, and the method is described. (LBS)

8174 POLARIZATION AND PROTON ASYMMETRY IN $e^- + e^+ \rightarrow p + \bar{p}$ ANNIHILATION IN THE CASE OF THE EXISTENCE OF WEAK NEUTRAL CURRENTS. Kerimov, B. K.; Samsonenko, N. V.; Kavasaki, Izamu. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 93-100(1974). (In Russian).

Calculations were made in the center-of-mass system on the differential and total cross section of the annihilation of longitudinally-polarized and transversely-polarized electrons and positrons to a pair of longitudinally-polarized protons and antiprotons. The expressions for the cross sections consist of three terms—electromagnetic, weak interaction, and interference. It is shown that the existence of the weak interaction ($\bar{e}$ e) ($\bar{p}$ p) should lead to a degree of longitudinal polarization different from zero in protons and antiprotons emitted at an angle θ = 90° (P(E) = 1.3 and 36% at E = 2.5 and 10 GeV and G = $G_F = 10^{-5}$ M^{-2}), to the presence of asymmetry "forward-back" in the angular distribution of the protons (A(E) = 1 and 12% at E = 2.5 and 10 GeV). The asymmetry exists even if all the particles are unpolarized, and to other effects which are absent in the case of a purely electromagnetic interaction. It is shown that in experiments with polarized particles it is possible to separate out the contributions of various form factors and to investigate them separately. (tr-auth)

8175 LEGENDRE POLYNOMIAL EXPANSION FOR THE KLEIN–NISHINA FORMULA FOR NONSTATIONARY ELECTRONS. Webster, J. B. III (Air Force Weapons Lab., Kirtland AFB, NM); Stephan, B. G.; Bridgman, C. J. J. Comput. Phys.; 14: No. 1, 29-30(Jan 1974).

Energy integrated coefficients for a Legendre expansion of the angular dependence of the differential cross section which describes Compton scattering from nonstationary electrons are presented. The electrons are assumed to have a Maxwellian velocity distribution and an analytic fit is presented for the dependence of these coefficients on photon energy and electron distribution temperature. If one wishes to use a Legendre expansion of the scattering kernel in a gray transport calculation, these coefficients may be used to aid in determining the degree of expansion required for the particular situations to be encountered in the problem. The fits presented will yield integrated coefficients whose accuracy are good to approximately one percent for photon energies between 0 and 1000 keV, and for electron distribution temperatures between 0 and 20 keV. These well behaved, smoothly varying energy integrated coefficients also serve as a check on the accuracy of arbitrarily constructed multigroup coefficients. (auth)

8176 MESON WITH ANOMALOUS MAGNETIC AND ELECTRIC QUADRUPOLE MOMENTS IN THE FIELD OF A PLANE ELECTROMAGNETIC WAVE. Radyuk, A. F.; Fedorov, F. I. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR; 18: No. 2, 118-121(Feb 1974). (In Russian).

By a covariant method a general exact solution is obtained to the problem of a vector meson with anomalous magnetic and electric quadrupole moments in the field of a plane electromagnetic wave. The solution is the sum of three linear independent solutions, that corresponds to the number of spin states of the vector particle. On setting equal to zero the parameters characterizing the additional moments the solution converts to an earlier-obtained solution for a structureless vector meson. (SJR)

8177 RECIPROCITY RELATIONS IN PION PHOTOPRODUCTION FROM ^{3}He AND ^{3}H AND THE $\Delta I < 1$ RULE. Haddock, R. P. (Univ. of California, Los Angeles). pp 246-248 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Reciprocity relations derived from pion photoproduction on

protons and neutrons were suggested as a method for testing possible maximal violations of C and T in the electromagnetic interactions of hadrons. However, the difficulties involved in the use of deuterium as a neutron target have not yet been overcome. A definitive test can be performed by using the neutron in a three-body bound state, in the reactions $\pi^{+3}H \rightleftarrows {}^3He\gamma$, or the proton on $\pi^{-3}He \rightleftarrows {}^3H\gamma$. The sensitivity of these reactions to T-noninvariance is calculated. (INIS)

8178 INTRODUCTION TO THE LIGHT CONE. Callan, C. G. Jr. (Princeton Univ., NJ). pp 264-279 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

Lectures are given on an approach to the problem of electroproduction scaling, known as the method of the light cone, based on the idea that the currents have simple short-distance behavior. Electron–positron annihilation is considered. (JFP)

8179 PROPERTIES OF NONCANONICAL SCALING. Mennotti, P. (Scuola Normale Superiore, Pisa, Italy). pp 323-330 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

Some general properties of the Compton amplitude and scaling functions are examined which are obtained in the presence of noncanonical singularities of the commutator forward matrix element on the light cone. The interest in examining such a situation is to see whether in the case of noncanonical singularities some pathological feature obtains which would enable one to reject the noncanonical case. It is found that no definite clash with commonly accepted principles emerges. (JFP)

8180 DEEP INELASTIC SCATTERING AND STRUCTURE OF THE NUCLEON. Calucci, G. (Univ., Trieste, Italy). Acta Phys. Acad. Sci. Hung.; 34: No. 4, 351-355(1973).

The parton model is used to determine by means of two simple examples what kind of information the deep inelastic scattering of electrons on protons can give about the structure of the nucleon. (JFP)

8181 CORRECTIONS TO THE g – 2 FREQUENCY IN WEAK FOCUSING STORAGE DEVICES DUE TO BETATRON OSCILLATIONS. Field, J. H.; Fiorentini, G. (CERN, Geneva). Nuovo Cim.; 21A: No. 2, 297-328(21 May 1974).

Spin motion equations in a rotating rest frame in which the particle's velocity and acceleration vectors are instantaneously at rest are derived. These equations are used to calculate the corrections due to betatron oscillations to the g – 2 frequency in weak focusing storage devices. The corrections are found up to second order in the (nonlinear) focusing field. Nonresonant and resonant solutions are derived and both magnetic and electric focusing fields are treated. Quantitative estimates are also given of depolarization effects near resonance. (auth)

8182 ON THE FINITENESS OF SCALING SUM RULES. Broadhurst, D.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Gunion, J.F.; Jaffe, R.L. Ann. Phys. (N.Y.) 81: No. 1, 88-112 (Nov 1973).

The convergence of sum rules relating the matrix elements of local operators to integrals over deep-inelastic structure functions is studied critically. It is found that the matrix elements may always be written as the $q^2 \to -\infty$ limit of finite expressions, regardless of the (Regge) asymptotic behavior of the structure functions or the possible occurrence of J=0 fixed singularities. The correct form of the sum rule for the operator Schwinger term is taken as a paradigm case. It is derived from the Bjorken–Johnson–Low theorem and agrees with the results of second order ϕ^3 theory (where the Schwinger term diverges logarithmically) and second order vector gluon theory (where it vanishes). Sufficient conditions for the finiteness of the operator Schwinger term are the scaling of the longitudinal structure function and the absence of J=0 fixed singularities with nonpolynomial residues. The treatment is readily applicable to other scaling and fixed q^2 sum rules needing regulation. A compendium of these is given. (auth)

8183 LOW-ENERGY THEOREMS AND DISPERSION RELATIONS TO ALL ORDERS IN THE ELECTROMAGNETIC INTERACTION. Soloviev, L.D. (Institute for High Energy Physics, Serpukhov, Moscow Region, USSR). Ann. Phys. (N.Y.) 81: No. 1, 80-87 (Nov 1973).

An S-matrix theory of the electromagnetic interaction without infrared divergences is proposed. With the help of it the effects of the soft (both real and virtual) photons are considered without perturbation theory approximations. The following results are obtained. (1) The terms of order k^{-1}, ln k, k^0 and k $\ln^2$ k are found in the bremsstrahlung matrix element where k is the radiated energy (they are expressed through the matrix element of the process without radiation). (2) It is shown, that if dispersion relations exist at nonzero photon mass, then they exist at zero mass also. (3) The first three terms of the series expansion in energy near the threshold are found for the Compton scattering matrix element at fixed momentum transfers. Relation of the obtained results to high-energy scattering and relativistic eikonal models is considered. (auth)

8184 PROTON STRUCTURE FUNCTIONS IN AN INFINITE RESONANCE O(4,2) MODEL. Wilson, R. (Physics Department, Stevens Institute of Technology, Hoboken, New Jersey 07030); Peierls, R.F. Ann. Phys. (N.Y.) 81: No. 1, 15-48 (Nov 1973).

The proton electromagnetic inelastic structure functions have been explicitly evaluated in a noncompact O(4,2) model for the spectrum of hadronic states, using the Barut–Corrigan–Kleinert infinite component wave equation. The resulting structure functions exhibit nontrivial scaling behavior in the Bjorken limit and give qualitative agreement with observation. They also satisy exactly the Callan–Gross relation. (auth)

8185 MULTIPOLE γN–Δ FORM FACTORS AND RESONANT PHOTO- AND ELECTROPRODUCTION. Jones, H.F.; Scadron, M.D. (Department of Physics, Imperial College, London SW7, England). Ann. Phys. (N.Y.) 81: No. 1, 1-14 (Nov 1973).

Multipole form factors for the γN–Δ vertex are defined explicitly as the coefficients of appropriate kinematic covariants. The relations with other decompositions of the vertex are fully explored and a complete set of angular distribution and cross-section formulae derived. The experimental and theoretical status of the magnetic dipole form factor is briefly reviewed. (auth)

8186 PROTON–NEUTRON MASS DIFFERENCE IN GAUGE THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Fayyazuddin (Rutherford High Energy Laboratory, Chilton, Didcot, Berkshire, England); Riazuddin. Ann. Phys. (N.Y.) 80: No. 1, 189-211 (Sept 1973).

The question of cancellation of logarithmic divergence appearing in the proton–neutron mass difference is studied in gauge theories of weak and electromagnetic interactions. In particular, we study the proton–neutron mass difference in three kinds of gauge models. It is found that the contribution from weak hadronic currents in two of the models cancels the logarithmic divergence arising from purely electromagnetic interaction, but as pointed out in the text these two models suffer from some other defects. In one of the models such a cancellation is not possible although the model is otherwise attractive. In this latter case, a mass renormalization counter term exists to absorb the infinity in the mass difference leaving the mass difference essentially a free parameter. (auth)

8187 DUAL PARTON MODEL AND THE PHOTOPRODUCTION OF PSEUDOSCALAR AND VECTOR MESONS IN THE HIGH ENERGY REGION. Bandyopadhyay, P.; Raychaudhuri, P. (Indian Statistical Institute, Calcutta–35, India); De, S.S. Ann. Phys. (N.Y.) 80: No. 1, 142-156 (Sept 1973).

On the basis of the dynamical dual model of strong interactions followed from the parton model of hadrons as discussed in an earlier paper, we study here the photo–production of pseudoscalar and vector mesons in the high energy region. To incorporate the concept of duality, it is taken that any two spin 1/2 pointlike constituents (partons) can form a π–meson cluster in the structure of a nucleon and the basic interaction involved in MB scattering is the interaction of the incident meson with the π meson in the structure of the nucleon. In this scheme, the amplitudes for the photoproduction of mesons such as γN–Nπ, γN–Nρ, and γN–Nω in the high energy region can be related with the amplitudes for the process $\gamma\pi \to \pi\pi$, $\gamma\pi \to \pi\rho$, and $\gamma\pi \to \pi\omega$, respectively. To calculate the amplitudes for the relevant process we also consider a factor corresponging to the structural rearrangement of partons involved in duality diagrams. To obtain the cross sections, we take into account photon–vector meson analogy, though the naive form of the vector dominance model (VDM) has not been considered here. From a knowledge of the coupling constants $^{\gamma}\rho^2/4\pi$, $^{\gamma}\omega^2/\phi\pi$, $^{\omega}\omega\rho\pi/4\pi$, and $^{\omega}\rho\pi\pi/4\pi$ we obtain the differential cross sections which are in excellent agreement with experimental results. Also we obtain a good fit for the scattering process γN–Nπ at backward angles. For the vector meson production processes, we have contributions from the diffraction mechanism also apart from the amplitudes considered here. In the region where the contribution from the diffraction part is negligible, we obtain the relation $(d\sigma/dt)(\gamma p \to p\rho^0)/(d\sigma/dt)(\gamma p \to p\omega^0) = \gamma_\omega^2/4\pi/\gamma_\rho^2/4\pi \simeq 7$ which is in nice agreement with experiments. Finally, it is shown that, though the vector meson dominance is not considered here, the universality of the vector meson coupling with hadrons follows directly from the present model. (auth)

8188 ASYMPTOTIC LIMIT OF $\sigma(e^+ + e^- \to \text{hadrons})/\sigma(e^+ + e^- \to \mu^+ + \mu^-)$. Terazawa, H. (The Rockefeller University, New York, New York 10021). Phys. Rev. Lett. 32: No. 12, 694-695 (25 Mar 1974).

Combining the low-energy theorem by Crewther and by Chanowitz

and Ellis on the anomalous vertex function for partially conserved dilation current and a new result from the most conventional vector-meson dominance, we predict the asymptotic limit of the ratio $\sigma(e^+ + e^- \to \text{hadrons})/\sigma(e^+ + e^- \to \mu^+ + \mu^-)$ to be $R \simeq 16\pi^2/f_0^2 = 5.7 \pm 0.9$, which is in remarkable agreement with the preliminary data from the Cambridge Electron Accelerator $e^+ - e^-$ colliding-beam experiment but in strong contradiction with the other predictions $R = 2/3$ and $R = 2$ in the single- and three-triplet fractionally charged quark models. (auth)

8189 POSITIVITY RESTRICTIONS ON NUCLEON COMPTON AMPLITUDES. De Rújula, A.; De Rafael, E. (Institut des Hautes Études Scientifiques, 91-Bures-sur-Yvette). Ann. Phys. (N.Y.) 78: No. 1, 132-175 (15 May 1973).

The complete set of restrictions which "nonforward" absorptive Compton amplitudes have to satisfy as a consequence of positivity is derived. These restrictions are useful in setting upper and lower bounds to observables governed by nonforward absorptive amplitudes. Various applications of the positivity condition are discussed. (auth)

8190 S- AND T-CHANNEL TRANSFORMATION MATRICES FOR HELICITY AND INVARIANT AMPLITUDES FOR $\gamma+N\to1^+N$. Parsons, R.G.; Manny, B.L.; Clark, R.B. (Center for Particle Theory, The University of Texas at Austin, Austin, Texas 78712). Ann. Phys. (N.Y.) 80: No. 2, 387-396 (Oct 1973).

The Algebraic transformation matrices, valid for all s and t, connecting the s- and t-channel helicity amplitudes to a corresponding set of gauge invariant covariant amplitudes are presented for the photoproduction process $\gamma+N\to1^+N$. (auth)

Weak

Refer also to abstract 8511.

8191 CALCULATION OF THE INTEGRAL MULTIPLICITY OF μ^- MESONS IN THE HIGH ENERGY REGION BY THE THEORETICAL NUMERICAL METHOD ON A COMPUTER. Boos, E. G.; Efimov, A. K.; Kolomeets, E. V.; Kupchishin, A. I.; Shigaev, B. N. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 58-62(1973). (In Russian).

The coupling coefficients of the μ meson component of cosmic radiation were calculated with a consideration of the distributions from the inelasticity coefficients, the angular distributions of the primary and secondary particles, and diagrams of the directional effect of muon detectors. (tr-auth)

8192 LIGHT CONE EXPANSION, CURRENT ALGEBRA, AND σ-COMMUTATORS. Andrei, N.; Gomberoff, L. (Tel Aviv Univ., Israel). Nuovo Cim.; 21A: No. 2, 277-288(21 May 1974).

It has been shown recently that, in order to have consistency between some current algebra sum rules, the light-cone expansion leading to Bjorken scaling has to be modified. The required modifications are shown to be consistent with current algebra, but lead to a new scaling regime and to Schwinger terms in σ-commutators. These Schwinger terms appear only in commutators involving nonconserved currents, and may, therefore, provide a natural explanation for the large value of ξ in K_{l3}-decay, without destroying any of the successful predictions based on current algebra. (auth)

8193 NEUTRINO SCATTERING ON A BOUND ELECTRON. Zapryagaev, S. A.; Rapoport, L. P. (Voronezh State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 148-149(1974). (In Russian).

The theoretical consequence of the existing theory of weak interactions is the prediction that it is possible to scatter a neutrino or antineutrino on an electron. The scattering cross section on a free electron has already been obtained, but it would be of interest to find out how the total scattering cross section would vary when a neutrino strikes a bound electron. This study considers the scattering cross section of a neutrino beam on an electron in the atomic 1-s state. Recoil of the nucleus is neglected. An expression is given for the probability amplitude for neutrino scattering, and an expression is derived for the differential probability of scattering. An expression is then given for the total scattering cross section of a neutrino on a bound electron, and the results are compared graphically to the scattering cross section on a free electron. (SJR)

8194 LEPTON CHARGE AND MODEL OF WEAK INTERACTIONS WITH $\mu-e$ TRANSITIONS. Nikolaev, N. N.; Shimatikov, M. Zh. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys.; B72: No. 3, 502-508(1974).

The gauge model of weak interactions is proposed and $\mu^+ \to e^+$ transitions predicted by the model are discussed. Estimates are given for $\mu^+ \to e^+$ transitions on hadrons like $K^+ \to \pi^- \mu^+ e^+$ with $\Gamma(K^+ \to \pi^- \mu^+ e^+) \simeq 10^{-11}\,\Gamma(K^+)$ and μ^- capture on nuclei with $W(\mu^- \to e^+) \simeq 10^{-12}\,W(\mu^- \to \nu)$. Single μ^+ production in e^+ beams with a cross section $\delta \sim 10^{-42}$-10^{-41} cm^2 is predicted. (auth)

8195 OCTET DOMINANCE IN NONLEPTONIC DECAYS. Riazuddin (Daresbury Nuclear Physics Laboratory, Daresbury, Nr. Warrington, Lancashire, England). Ann. Phys. (N.Y.) 78: No. 1, 271-283 (15 May 1973).

The question of octet enhancement for the nonleptonic decays is studied within the framework of a current-algebra approach. By writing an unsubtracted dispersion relation for the matrix elements $\langle B_\alpha|H_w|B_\beta\rangle$ and $\langle M_\alpha|H_w|M_\beta\rangle$ (B denoting a 1/2+ baryon and M a 0- meson) in the momentum transfer squared variable t and using the assumption of threshold dominance, namely that two pseudoscalar meson states dominate the absorptive parts of the above matrix elements and that in the chiral limit the meson-baryon and meson-meson scattering amplitudes which enter in the absorptive parts are exactly given by current algebra low energy theorems, it is shown that the above matrix elements are octet enhanced without assuming the octet transformation property for H_w. Further it is shown that the d/f ratio for the octet enhanced matrix elements $\langle B_\alpha|H_w|B_\beta\rangle$ satisfies the relation $(d/f) = (3/10)[(3(f/d)_A{}^2-1)/(f/d)_A]$, where $(f/d)_A$ denotes the f/d ratio of the axial vector current baryon couplings. The implications of this result for the s- and p-wave hyperon non-leptonic decays are discussed. (auth)

Strong (General)

Refer also to abstract 8586.

8196 (RHEL-72-1(Vol.2), pp 347-354) DIFFRACTIVE EXCITATION MODEL. Hwa, R. C. (Univ. of Oregon, Eugene). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

In the discussion of the diffractive excitation model the mass distribution of the excited state is derived in the Regge formalism. The pomeron bootstrap, the diffraction peak, limiting cross sections, the excitation and proton spectra, pion spectra and average multiplicity, the distribution at wee x, and the two-particle correlation are described. (JFP)

8197 (RHEL-72-1(Vol.2), pp 355-365) TWO PARTICLE CORRELATIONS IN INCLUSIVE REACTIONS. Berger, E. L. (Argonne National Lab., IL); Jacob, M. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Two particle inclusive distributions and correlation functions are computed from a model which emphasizes single production of resonance-like hadrons (novas) which cascade decay through pion emission. Strong positive correlations are predicted at small values of the relative rapidity (Δy) of the final pions. The magnitude and energy dependence of $\langle n_{\pi^-}\rangle$ and $\langle n_{\pi^-}(n_{\pi^-}-1)\rangle$ are reproduced correctly. Good agreement is obtained with experimental $d\sigma/dy$, $d^2\sigma/dy_1dy_2$, and $C(y_1,y_2)$ from data on $\pi^+p \to \pi^-\pi^-X$ at 18.5 GeV/c. (auth)

8198 (RHEL-72-1(Vol.2), pp 414-442) SCALING OF MULTIPLICITY DISTRIBUTIONS IN HIGH ENERGY HADRON COLLISIONS. Koba, Z.; Nielsen, H. B.; Olesen, P. (Univ. of Copenhagen). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

It is shown that asymptotically $\langle n\rangle\sigma_n(s)$ is only a function of $n/\langle n\rangle$, where $\sigma_n(s)$ is the multiplicity distribution. The essential assumption in deriving this result is that multiparticle inclusive cross sections obey the scaling law. It is also pointed out that the available data below 30 GeV may possibly indicate rather long range correlations in multibody reactions. (auth)

8199 EFFECTIVE RANGE FOR THE GENERATION OF BARYON RESONANCES. Takibaev, Zh. S.; Boos, E. G.; Temiraliev, T.; Kholmetskaya, A. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 6-9(1973). (In Russian).

The spatial range for the generation of resonances was studied. The distribution of transverse isobar momenta was analyzed. It was shown that the generation range was increased for isobars with isospin $T = 3/2$ which indicates the very peripheral character of the formation of these resonances. (tr-auth)

8200 RELATIVISTIC QUANTUM DYNAMICAL MODEL BASED ON THE CLASSICAL STRING. Carlson, C. E. (College of William and Mary, Williamsburg, VA); Chang, L. N.; Mansouri, F.; Willemsen, J. F. Phys. Lett.; 49B: No. 4, 377-380(29 Apr 1974).

Motivated by geometrical considerations of the string model, a

dynamical theory of composite particles is constructed that is Poincaré invariant in four dimensions, with no tachyons and no ghosts. The resulting physical states lie on indefinitely rising trajectories. (auth)

8201 SEMI-INCLUSIVE RAPIDITY CORRELATIONS IN CLUSTER EMISSION MODELS. Berger, E. L. (CERN, Geneva). Phys. Lett.; 49B: No. 4, 369-373(29 Apr 1974).

From an approach to multiparticle production in which clusters of hadrons are emitted, the formalism is developed for an analysis of rapidity correlations in the central region at fixed multiplicity. Predictions are given for multiplicity, energy, and rapidity dependence of correlation functions. (auth)

8202 HIGH ENERGY NUCLEAR SCATTERING AND RISING CROSS SECTIONS. Samaranayake, V. K. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 9: No. 17, 677-681(27 Apr 1974).

Comments are made on the consequences of various parametric forms used to study the asymptotic behavior of hadron-nucleus cross sections. (LBS)

8203 PLANAR DIAGRAM THEORY FOR STRONG INTERACTIONS. 't Hooft, G. (CERN, Geneva). Nucl. Phys.; B72: No. 3, 461-473(1974).

A gauge theory with color gauge group U(N) and quarks having a color index running from one to N is considered in the limit $N \to \infty$, g^2N fixed. It is shown that only planar diagrams with the quarks at the edges dominate; the topological structure of the perturbation series in 1/N is identical to that of the dual models, such that the number 1/N corresponds to the dual coupling constant. For hadrons N is probably equal to three. A mathematical framework is proposed to link these concepts of planar diagrams with the functional integrals of Gervais, Sakita and Mandelstam for the dual string. (auth)

8204 MAKING THE MASSLESS STRING MASSIVE. Chodos, A.; Thorn, C. B. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys.; B72: No. 3, 509-522(1974).

The possibility of associating a finite rest mass density with the relativistic string at the classical level is investigated. A modification of the massless Lagrangian which reduces in the non-relativistic limit to the usual non-relativistic string is chosen. After studying some simple classical motions of this system, the massive string is quantized in a similar way to the massless case. The Regge trajectories are linear as in the massless case, but their intercepts are shifted downward from unity by an amount proportional to the square of the rest mass density parameter. The naive quantization procedure is covariant only in 25 space-time dimensions. However, the extra degree of freedom implicit in the mass density can be used to modify the Lorentz generators so that covariance is maintained for any dimension less than 25. Hadronic interactions are envisaged to be introduced through the breaking and joining of strings, as in the massless case, and the problems associated with the construction of covariant amplitudes when $D < 25$ are discussed. (auth)

8205 DUAL MODEL OF NEVEU AND SCHWARZ. Rosenweig, C. (Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-3069. Mem. Accad. Sci. Torino, Cl. Sci. Fis., Mat. Natur.; No. 19, 1-16(1974).

The formalism and structure of the modification of the dual resonance model proposed by Neveu and Schwarz is reviewed. Special emphasis is placed on the similarities between the new model and the conventional one. Then the most recent developments based on the Neveu-Schwarz model, the construction of chiral dual models and the first steps toward including fermions in the theory are surveyed. (auth)

8206 FACTORIZATION AS A SIMPLE GEOMETRICAL PROPERTY OF COMPOSITE SYSTEMS. Fishbane, P.M.; Trefil, J.S. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. Lett. 32: No. 7, 396-399 (18 Feb 1974).

We show that factorization holds to a very good approximation in the scattering of composite systems over a very large range of the geometrical size of the composite systems, the number of constituents, and the parameters of the constituent-constituent scattering amplitude, despite the fact that multiple-scattering terms may be important. (auth)

8207 PREDICTED NEW CLASS OF HADRONS AND THE AVERAGE PARTON CHARGE. Yock, P.C.M. (Department of Physics, University of Auckland, Auckland, New Zealand,). Ann. Phys. (N.Y.) 82: No. 2, 449-458 (Feb 1974).

A semiempirical mass formula of a particular parton model, in which it is assumed that partons are highly charged, requires the existence of a new class of hadrons, at least one of which must be absolutely stable and whose masses are of the order of a few GeV. Several experiments (with accelerators and cosmic rays) appear to support the notions that partons are highly charged and that a new class of hadrons exists. The recently reported particle of Niu et al., with an apparent lifetime $\sim 10^{-13}$ sec, may be a member of the new predicted class. (auth)

8208 ASYMMETRY IN PERIPHERAL PRODUCTION PROCESSES. Weiner, R.M. (Deutches Elektronen-Synchrotron, Hamburg, Germany). Phys. Rev. Lett. 32: No. 11, 630-633 (18 Mar 1974).

As a consequence of local excitation, an asymmetry with respect to the leading particle in peripheral production processes is predicted. It is interpreted in terms of heat propagation in hadronic matter. (auth)

8209 REGGE TRAJECTORY STRUCTURE OF THE AMATI-BERTOCCHI-FUBINI-STANGHELLINI-TONIN MULTIPERIPHERAL MODEL. Balakrishnan, V. (Tata Institute of Fundamental Research, Bombay, India). J. Math. Phys. (N.Y.) 15: No. 2, 247-257 (Feb 1974).

The Regge pole spectrum of the ABFST multiperipheral model with a resonance kernel is studied, using both the forward and nonforward partial-wave integral equations. Insight into the complicated pattern of the trajectory spectrum is provided by an analysis of the singularity structure of the basic kernel using appropriate representations for it, and by an elucidation of the process of generation of trajectories in the weak-coupling limit. This also establishes a framework for understanding the characteristics of the approximate solutions to the problem that are taken up subsequently. The trace approximations for both the nonforward and forward equations are worked out in detail. The traces involved are evaluated in convenient closed forms from which all the necessary information can be extracted easily. It is found that the approximation preserves, to a fair degree of accuracy, the trajectory-generating singularity structures of the relevant kernels, and that good 'effective' trajectory positions for the leading and secondary poles are obtained in both the forward and nonforward cases. It is also shown that, in this approximation, other phenomena such as complex Regge poles, the threshold behavior of the trajectories, and the intercept and slope of the leading trajectory can be investigated in a close simulation of the actual situation. Recent factorizable approximations are then examined from the point of view of the pole spectra they lead to, and it is concluded that, by and large, they oversimplify the problem and that their shortcomings are thus more extensive than those of the trace approximation. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 8278.

8210 (JINR-P2-7712) DEPARTURE FROM EXPONENTIAL DECAY LAW. Shirokov, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The time dependence of the decay law is discussed in the frame of a solvable theoretical model. A new quantum-mechanical definition of the decay law N(t) is proposed. It is shown that there exists such a description of an unstable state that N(t) decreases not slower than an exponent when $t \to \infty$. In the model frame other descriptions may be investigated which lead to nonexponential asymptotics for N(t). Some of them lead to the decay law which is practically exponential up to arbitrary large (but finite) time. The decay of the prepared unstable state is investigated. (auth)

8211 PERTURBATIVE SOLUTION OF A BETHE-SALPETER EQUATION. Hite, G. E.; Mueller-Kirsten, H. J. W. (Univ., Kaiserslautern, Ger.). Nuovo Cim.; 21A: No. 2, 351-367(21 May 1974).

The homogeneous and inhomogeneous Bethe-Salpeter equations of the Wick-Cutkosky model are considered in the ladder approximation and for unequal masses of the external particles. By means of a perturbation procedure, complete expansions are obtained for the solutions and Regge trajectories. In terms of these, a solution of the four-point amplitude is derived, and it is shown explicitly that the removal of the inhomogeneous term from the vertex equation implies the occurrence of a bound state in the four-point function which lies on the Regge trajectories derived from the homogeneous vertex equation. Finally, the asymptotic behavior of both the amplitude and the vertex function is derived for the case when one of the external particles is far off its mass shell. (auth)

8212 DIRECT DETERMINATION OF ETA-ZERO BRANCHING RATIOS. Kendall, B. N. (Brown Univ., Providence); Lanou, R. E. Jr.; Massimo, J. T.; Shapiro, A. M.; Guerriero, L.; Nicolini, C.; Salandin, G. A.; Tomasin, A. Nuovo Cim.; 21A: No. 2, 387-412(21 May 1974).

Decay branching ratios of the η^0-meson into 2γ, $3\pi^0$, $\pi^0\gamma\gamma$, $\pi^+\pi^-\pi^0$, $\pi^+\pi^-\gamma$ are presented. Neutral and charged modes are

detected in the same apparatus. Eta triggers are independent of the decay mode, being obtained from the neutron time of flight. The distribution of η decays among the various possible branches is derived from multiplicities of charged particles and gamma-rays observed in a double spark-chamber array. (auth)

8213 CURRENT–CURRENT SUGAWARA FORM AND PION–KAON SCATTERING LENGTHS. Ebrahim, A.; Serdaroglu, M. (Middle East Technical Univ., Ankara). Nuovo Cim.; 21A: No. 2, 249-264(21 May 1974).

It is shown that the $SU_2 \times SU_2$ invariant pion-kaon Lagrangians constructed by using the matrix method of Gürsey, or the covariant derivative method of Weinberg, or by reduction from an $SU_3 \times SU_3$ invariant Lagrangian for the pseudoscalar meson octet, respectively, do not all give the same result. It is further shown that only the pion–kaon Lagrangian obtained by using the matrix method can be expressed in general in the current–current Sugawara form in terms of the vector and the axial vector pion currents and the strangeness-changing currents. The origin of this discrepancy is due to a pion–kaon interaction term that is itself $SU_2 \times SU_2$ invariant and hence may be multiplied by an arbitrary parameter without spoiling the $SU_2 \times SU_2$ invariance of the Lagrangian. The matrix method, or equivalently the current–current Sugawara form, and the reduction method prescribe definite, though different, values for this parameter, whereas the covariant derivative method leaves the parameter undetermined. Since the pion–kaon scattering lengths depend on the value of this parameter, it is possible, in principle, to distinguish the various alternatives experimentally, if the pion–kaon scattering lengths can be measured to an accuracy of the order of (10 to 20) percent. In particular, such a measurement would provide a direct test of the current–current Sugawara form for the $SU_2 \times SU_2$ invariant pion–kaon Lagrangian. (auth)

8214 ELEMENTARY PARTICLE SCATTERING LENGTHS AND RESONANCES. Peaslee, D. C. (Massachusetts Inst. of Tech., Cambridge). Aust. J. Phys.; 27: No. 1, 13-20(Feb 1974).

An investigation is made of the relation between scattering lengths and resonances in a two-nucleon system. For resonances E_0 near zero energy the usual determination of an effective optical potential in mesonic atoms is limited, and it is shown here that the scattering length can only be represented usefully as a sum over resonances of the compound system if the condition $|E_0/D| \gg (\rho\,\Omega_0)^{1/3}$ is satisfied, where D is the average spacing of s-wave states, ρ the density of target nucleons and Ω_0 the Compton volume of the reduced system. This condition is seen to be valid for $\pi\pi$, πK and $K\bar{K}$ interactions and these systems are considered in some detail. It is shown that knowledge of the level shifts of each of these examples can help resolve present uncertainties in associated boson structure. (auth)

8215 CONSTRUCTION OF PHENOMENOLOGICAL $\pi\pi$ AMPLITUDES. Basdevant, J. L. (Laboratoire de Physique Theorique et Hautes Energies, Paris); Froggatt, C. D.; Petersen, J. L. Nucl. Phys.; B72: No. 3, 413-453(1974).

A comprehensive description of a scheme for applying the Roy equations to $\pi\pi$ phenomenology is given. The method is applied to recent high statistics $\pi\pi$ experiments. The complete set of amplitudes consistent with these experiments and with the theoretical constraints of analyticity, crossing and unitarity are presented. The implications of these results are considered and future experiments which could remove the final ambiguities in the low-energy $\pi\pi$ amplitude are discussed. (auth)

8216 DUALITY OF THE $\pi\pi$ SCATTERING AMPLITUDE. Ukawa, A. (Tokyo Univ.); Fukugita, M.; Oyanagi, Y. Nucl. Phys.; B72: No. 3, 474-480(1974).

Dual structure of the $\pi\pi$ scattering amplitude was investigated in terms of the finite energy sum rule using recent phase-shift data. The amplitude shows properties quite consistent with the simple dual model in the framework of the two component theory of duality. (auth)

8217 ALGEBRAIC APPROACH TO THE SATURATION OF CHIRAL ALGEBRA. Savoy, C. A. (CERN, Geneva). pp 246-252 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

Some recent work on the saturation of chiral algebra is discussed with an attempt to use empirical facts as a guide to the choices. Only one-particle hadronic states, i.e., meson and baryon resonances (and bound states) are considered in the $p \to \infty$ frame. (JFP)

8218 A RELATIVISTIC QUARK MODEL FOR MESONS BASED ON NUMERICAL SOLUTIONS OF THE BETHE-SALPETER EQUATION. Guth, A.H. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Ann. Phys. (N.Y.) 82: No. 2, 407-448 (Feb 1974).

A study is made to determine if the results of the nonrelativistic quark model can be reproduced by a fully relativistic model of deeply bound spin-1/2 quarks. It is found that the relativistic model does not reproduce the nonrelativistic results, even when the quarks have nonrelativistic momenta. However, the model is rather successful in accounting for the known properties of mesons. Numerical solutions to the Bethe-Salpeter equation are obtained for pseudoscalar and vector bound states of equal mass quark-antiquark pairs, with either a scalar, pseudoscalar, or neutral vector exchange interaction. The interaction function corresponds to single particle exchange, with the addition of either one or two regulating terms. It is found that the second regulator allows the internal quark momentum to be nonrelativistic, but that the spinor structure of the wave function remains highly relativistic. Only the scalar interaction can account for the observed spectrum of states. The pseudoscalar interaction yields a vector state of lower mass than the pseudoscalar state, and the vector interaction leads to a vector state which lies approximately one quark mass above the pseudoscalar state. The λ quark is taken as slightly heavier than the p and n, and the perturbation treatment of the mass difference leads to a quadratic mass formula. The decay amplitudes for π, $K \to \mu\nu$ are calculated, and it is found, independent of parameters, that $f_\pi \simeq f_K$ for either a scalar or vector interaction, in agreement with experiment and in contrast with the nonrelativistic model. The amplitudes for ρ^0, ω, $\phi \to e^+e^-, \mu^+\mu^-$ are also calculated, but in this case the ratios (again parameter independent) are in minor discrepancy with experiment. The question of the additivity of quark amplitudes is examined by calculating (with significant restrictions) the magnetic moments of the vector mesons and the amplitudes for magnetic transitions such as $\omega \to \pi^0\gamma$. The magnetic moments of the vector mesons have the same (trivial) ratios to each other as in the nonrelativistic model, but they are strongly enhanced over the sum of the quark magnetic moments. The amplitude for magnetic transitions, however, is related to the quark magnetic moments in approximately the same ratio as in the nonrelativistic model. The model is also used to obtain parameter dependent predictions for the masses and decay amplitudes. These predictions are not experimentally correct, but are generally well within an order of magnitude for a wide range of the parameters. The most significant defect discovered of the presence of ghost states (the daughters of the vector mesons, with $J^{PC} = 0^{+-}$) with masses of about 2 BeV. (auth)

Strong (Baryon No. = 1)

8219 (FRNC-TH-25) STUDY OF THE $K^-p \to \Lambda^0\pi^0$ AND $K^-p \to \Sigma^\pm\pi^\mp$ REACTIONS BETWEEN 1 GeV and 2 GeV/c. Berthon, A. (Paris-6 Univ., 75 (France)). 1970. 144p. (In French). INIS.

Thesis.

Two body reactions in which the final baryon has a strangeness of -1 (either a lambda or sigma particle) were studied in the framework of a systematic exploration of the K^- proton interaction. The experimental results and their presentation are discussed together with the potentialities and limitations of partial wave analysis. The consequences of the results obtained in classifying the resonances and principal tendencies characterizing the intermediate energy zone considered are examined. A zone was reached above 2 GeV in which important exchange mechanisms began to appear, the contribution of the resonances to the imaginary part of the amplitudes being consistent with duality principles. (auth)

8220 (HU-TFT-73-17) SEARCH FOR SATURATION OF ISOSPIN BOUNDS AND ISOSPIN ANALYSIS OF $\pi N - K\Sigma$ AND $KN \to \pi\Sigma$. Korkea-aho, M.; Toernqvist, N. A. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 1973. 27p. INIS.

By performing an isospin analysis of $\pi N \to K\Sigma$ and $KN \to \pi\Sigma$ it is found that the isospin bounds are satisfied as equalities (or slightly violated) in three regions at $\theta = 0°$ in both reactions at all energies studied for small forward angles in $\pi N \to K\Sigma$ above 1.7 GeV/c near $\theta \simeq 90°$ between 600 and 800 MeV/c in $KN \to \pi\Sigma$. In $\pi N \to K\Sigma$ the analysis indicates that a different set of high mass (2 GeV) resonances dominate in the $K\Sigma$ channel than those known from $\pi N \to \pi N$. (auth)

8221 (RHEL-72-1(Vol.2), pp 257-276) SYMMETRIES OF REGGE–REGGE CUTS. Worden, R. P. (Rutherford High Energy Lab., Chilton, Eng.). 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Regge–Regge cuts are shown to satisfy strong symmetry constraints in any model which incorporates Finkelstein's cut selection rule, SU(3) symmetry of Regge residues, and exchange de-

generacy of trajectories and residues. These imply, amongst other things, the strong suppression of Regge–Regge cuts in pion–nucleon charge exchange, arising from a cancellation between $\rho-P'$ and $A_2-\omega$ cuts. Therefore if Finkelstein's selection rule is valid, the πN charge exchange amplitudes cannot be understood by adding Regge–Regge cuts to an absorbed ρ pole amplitude. (auth)

8222 DYNAMICS OF THE ASYMMETRY IN π^-p INTERACTIONS AT 40 AND 60 GeV. Murzin, V. S.; Sarycheva, L. I.; Smirnova, L. N.; Tret'yakova, M. I. (Moscow State Univ.). Yadern. Fiz.; 19: No. 4, 861-868(Apr 1974). (In Russian).

The angular distributions in rapidity and asymmetry parameters for 40 and 60 GeV energies are considered to study the dynamics of π^-p interactions. It is shown that at 40 as well as at 60 GeV there are various types of events differing by the value of asymmetry of the final particles. The part of symmetrical interactions is the same at both energies. The degree of asymmetry characterized by the Lorentz factor γ_{SC} is energy independent. (auth)

8223 SOME RELATIONS BETWEEN PARAMETERS OF THE πN SCATTERING IN THE CROSSOVER POINT OF THE DIFFERENTIAL CROSS SECTIONS. Zamiralov, V. S.; Kurbatov, A. F.; Titov, V. M. (Moscow State Univ.). Yadern. Fiz.; 19: No. 4, 921-925(Apr 1974). (In Russian).

In the crossover point of the elastic πN-scattering differential cross sections a condition is presented that relates the polarization parameters for the πN charge exchange reaction and the elastic scattering. Comparison with the results of the amplitude analyses at $p_L = 6$ GeV/c is carried out. A sum rule is found for phases of the amplitudes without helicity flip, that is sensitive to the choice of a model for the charge exchange reaction. (auth)

8224 HOW LARGE IS THE ρ-MESON LONGITUDINAL COUPLING. Faiman, D. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett.; 49B: No. 4, 365-368(29 Apr 1974).

It is pointed out that the relative phases of $\pi N \to \rho N$ resonant amplitudes observed recently to have signs consistent with unbroken $SU(6)_W$ symmetry are even more consistent with a broken form of this symmetry in which the longitudinal ρ-meson coupling vanishes. One important partial wave amplitude that could distinguish between these models is suggested, and the use of a different set of basis states for describing the amplitudes is adjusted. Some theoretical implications that would result from the absence of any substantial longitudinal ρ-meson coupling to baryons are discussed. (auth)

8225 UNITARITY EQUATION IN A FIXED MOMENTUM, TRANSFER REPRESENTATION. Roth, B. (Brooklyn Coll.). Nucl. Phys.; B72: No. 3, 523-539(1974).

An extension of the fixed momentum transfer representation for an S-matrix representation of elementary particles is developed. In this representation it is postulated that a function S^2_U on the second sheet can be found such that the matrix product of SS^2_U is analytic everywhere in a complex energy plane, and S^2_U is a continuation of S^* in the neighborhood of the right-hand cut. The problem of π^+p scattering is considered. The kinematic variables are continued from the physical region to the neighborhood of the Born pole, and the unitarity equation is there applied. A function of S^2_U was chosen there with parameters determined by unitarity. Two calculations were made, each with a different choice for the form of S^2_U. It is shown how unitarity determines the coupling constant together with the values of the parameters of S^2_U. The calculated value of the coupling constant, in both cases, is ~16, in good agreement with experiment. (auth)

8226 RESONANCE DECAY CONTRIBUTIONS AND REGGE TRAJECTORY IN $K^+p \to K^0X^{++}$. Hontebeyrie, M.; Noirot, Y.; Rimpault, M. (Univ., Bordeaux). Nucl. Phys.; B73: No. 1, 57-76(1974).

A triple Regge analysis of the inclusive reaction $K^+p \to K^0X^{++}$ is considered, taking into account the fact that, for a non-negligible fraction, the K^0's are decay products of K^* resonances. In that way, it is possible to achieve a very good description of the inclusive distributions over an extended range in M^2 and t, with the canonical ρ-A_2 Regge trajectory $\alpha(t) = 0.5 + t$. (auth)

8227 THREE-BODY FORCES. Brown, G. (State Univ. of New York, Stony Brook). pp 135-139 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Various theories of pion-mediated three-body interactions are discussed. It is shown that in the static limit off-shell and on-shell pion-nucleon scattering amplitudes are the same. Triton binding energy and isobaric states are also considered, including the effects of the $N^*_{\frac{3}{2}}$ resonance. (INIS)

8228 KINEMATICAL EFFECTS IN THE MULTI-REGGE MODEL AND APPROACH TO SCALING IN THE CENTRAL REGION. Blutner, R. (Karl-Marx Univ., Leipzig). Nucl. Phys.; B73: No. 1, 125-140(1974).

The careful treatment of the kinematics of the MRM in the central region leads to an increase of the structure function towards its asymptotic value like $a + b\mu/\sqrt{s}$ where μ is the transverse mass of the produced particle. This is in good agreement with experimental data on $\pi^+p \to \pi^- + \ldots$ from 3.7 to 18.5 GeV/c and $pp \to \pi^+ + \ldots$ at primary momenta from 22 to 1500 GeV/c. (auth)

8229 PREDICTIONS FOR PION–NUCLEON BREMSSTRAHLUNG. Vignola, F. F. (Univ. of Oregon, Eugene). pp 93-95 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The total model independent part of the pion–nucleon bremsstrahlung differential cross section is calculated to show its use in the estimation of the magnitude of the off-energy-shell effects. Some preliminary results are presented which demonstrate the application of the calculation. (auth)

8230 K-MATRIX ABSORPTION MODEL FOR THE PION NUCLEON SYSTEM. Drechsler, W. (Max-Planck-Institut für Physik und Astrophysik, Munich, Germany). Ann. Phys. (N.Y.) 80: No. 1, 157-188 (Sept 1973).

A model based on a multichannel K-matrix formalism is used to analyze pion–nucleon scattering data. The Pomeranchuk term has in this description both a helicity nonflip and a helicity flip component, each one being capable of showing besides the dominant imaginary part a small real contribution. This more complicated nature of the vacuum terms implies a more involved absorptive correction for the Reggeized input Born terms being now different for helicity nonflip and helicity flip transitions. It is shown that such a model which builds up, via unitarity, the Pomeranchuk contribution from multiple exchanges of lower lying trajectories, generating at the same time a definite absorption mechanism in two-body scattering processes, describes well elastic π^+p scattering and accounts for detail of the π^-p charge exchange reactions such as the dip structure of the differential cross section and the polarization. (auth)

8231 APPLICATION OF THE ACCELERATED-CONVERGENCE EXPANSION TO PION–NUCLEON SCATTERING. Arndt, R.A.; Hackman, R.H.; Roper, L.D. (Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). Phys. Rev. Lett. 32: No. 1, 31-34 (7 Jan 1974).

The accelerated-convergence expansion has generated some controversy in applications to single-energy analyses of kaon–nucleon scattering. We have applied this expansion to pion–nucleon scattering at 490 MeV as the first test of the method in a region where strong s-channel effects are in evidence. The χ^2 values obtained from the accelerated-convergence-expansion analyses are in no case lower than those obtained from the corresponding conventional analyses, and we make several comments to explain this result. (auth)

8232 REGGEIZED SYMMETRY MODELS AND PION–NUCLEON SCATTERING IN FORWARD AND BACKWARD DIRECTIONS. Rashid, A.M.H. (Imperial College of Science and Technology, Prince Consort Road, London SW7, England 2BZ). Ann. Phys. (N.Y.) 80: No. 2, 397-424 (Oct 1973).

A Reggeization procedure is developed for higer symmetry schemes and its relationship with the $SU(6) \times SU(6)$ Reggeization is exhibited. The kinematic singularities arising from $SU(6)_W$-invariant vertex functions are removed with the help of fixed cuts and the resulting scattering amplitudes are extrapolated to hadron poles. The essentially parameter free theory thus obtained is shown to lead to reasonable forward and backward differential cross sections in pion–nucleon scattering at high energies. (auth)

8233 A TEST OF VECTOR-MESON DOMINANCE IN REGGEIZED HIGHER SYMMETRY MODEL. Rashid, A.M.H. (Imperial College of Science and Technology, Prince Consort Road, London, SW7 2BZ, England). Ann. Phys. (N.Y.) 80: No. 2, 425-440 (Oct 1973).

The requirements of the vector-dominance model on the smoothness of the invariant amplitudes for the process $\pi + N \to + N$ are investigated with the $SU(6)_W$-invariant vertex functions thus generalizing the electric Born model of Cho and Sakurai. However, it is shown that their conclusions remain unaltered. A Reggeized version of the model can explain the forward peak in the photo-production experiment provided the pion-conspirator trajectory is assumed to contribute. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 8361 and 8372.

8234 (JINR-P4-7722) OFF-SHELL T AND K-MATRICES FOR N–N POTENTIALS TAKING INTO ACCOUNT SHORT-RANGE FORCES BY BOUNDARY-CONDITION MODEL. Efimov, V. N.; Shul'ts, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

It was shown that the off-shell T and K-matrices can be obtained by means of boundary conditions imposed upon the off-shell wave function only. With a potential outside the boundary condition radius the proposed method permits to deduce, in a rather simple way, a renormalized Lippman-Schwinger equation. The S-components of the T and K-matrices are considered in detail using a potential of the exponential type in the exterior region. For such types of potentials a rather effective method for factorizing the K matrix is given. Parameter fits to the $^1S_0$ and $^3S_1$ phases are presented for several values of the boundary condition radius. (auth)

8235 (RHEL-72-1(Vol.2), pp 277-292) HIGH ENERGY SCATTERING DATA AS A FUNCTION OF THE KINEMATIC VARIABLE N^2. Leader, E. (CERN, Geneva); Pennington, M. R. 1972.

From 4th international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The main result of the study of high energy scattering data as a function of the kinematic variable n^2 is embodied in the suggestion that describing scattering amplitudes as a function of s and n^2 instead of s and t could lead to simplifications in the sense that all effects seen can be taken to be of dynamical origin. Cross sections for p + p, π^- + p, and K^+ + p elastic scattering are discussed. (JFP)

8236 CONTRIBUTION FROM THE DEUTERON D STATE TO THE REACTION pd → ppn AT T_p = 600 MeV. Golovin, B. M.; Kul'dzhanov, I. K.; Lykasov, G. I.; Khamraev, F. Sh. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 4, 820-824(Apr 1974). (In Russian).

It is shown that an account of the deuteron D state in the reaction pd → ppn at T_p = 600 MeV changes essentially the ratio of contributions from single and double scatterings to the amplitude of the process in view. Meanwhile, the conclusion that it is necessary to take the rescattering effects into account for this process is valid even with account of the D-wave part in the deuteron function. Sensitivity of polarization parameters to introduction of the D wave in the deuteron ground state is investigated. (auth)

8237 CHARGE EXCHANGE OF FAST NUCLEONS ON DEUTERONS IN GLAUBER THEORY. Lykasov, G. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 4, 825-829(Apr 1974). (In Russian).

The proton charge exchange on deuterons pd → n(pp) is studied in Glauber theory with spin dependence of NN scattering amplitudes. It is shown that the charge exchange differential cross section at high energy (T_p > 1 GeV) and zero angle is completely determined by the part of the charge exchange pn → np cross section depending on nucleon spins. In this case Glauber corrections are of the order of 20 to 25%. (auth)

8238 FERMI-MOTION EFFECTS IN NEUTRON STRIPPING CROSS SECTION FROM RELATIVISTIC DEUTERON–NUCLEUS COLLISIONS. Bertocchi, L. (Univ., Trieste, Italy); Tekou, A. Nuovo Cim.; 21A: No. 2, 223-235(21 May 1974).

The angular distribution of the proton in neutron stripping reactions, from relativistic collisions of deuterons with complex nuclei, is computed by means of Glauber's theory. The effect of Lorentz contraction on Fermi motion is explicitly taken into account and the result is expressed as an incoherent multiple-scattering series. (auth)

8239 PION-DEUTERON BACKWARD SCATTERING IN THE RESONANCE REGION. Ferreira, E. (Pontificia Universidade Catolica, Rio de Janeiro); Pinguelli Rosa, L.; Thome Filho, Z. D. Lett. Nuovo Cim.; 9: No. 17, 707-710(27 Apr 1974).

An attempt is made to show the effects of different possible choices in the kinematical variables determining the πN amplitude, which can eventually affect the energy dependence of the πd backward differential cross section. The πd elastic differential cross section is calculated at 160° for energies in the 3-3-resonance region, by taking into account the off-shell effects. The results are discussed. (LBS)

8240 INCLUSIVE PION PRODUCTION OFF NUCLEI. I. Proton Beams. Bertocchi, L. (Univ., Trieste, Italy); Tekou, A. Nuovo Cim.; 21A: No. 2, 201-222(21 May 1974).

The theory of the inclusive production of high momentum pions from protons incident on nuclear targets is developed by means of a generalization of the Glauber theory. The energy and momentum distribution are found to be expressed in terms of a double series, one converging faster for small values of the longitudinal momentum transfer, the other for small values of the transverse momentum transfer. Every term of these series has a different dependence upon the mass number of the target nucleus. (auth)

8241 SOME ASPECTS OF THE THREE NUCLEON PROBLEM. Slaus, I. (Univ. of California, Los Angeles). pp 272-298 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A discussion is presented of the sensitivity of various three body observables to the N-N interaction. The problem is approached in three ways: exact treatment, formulation of a model and from the model proceed to improve the exact calculation, and to search experimentally for regions of maximum discrepancy between the data and some simple model and to guide the theory to investigate the most plausible missing terms of the N-N interaction. Evidence is presented to show that models based on Faddeev theory fit the three nucleon data quite well and much better than any other model, and that the data are sensitive to the N-N interaction. (INIS)

8242 COMMENTS ON SOME 3-NUCLEON REACTIONS. Phillips, A. C. (Univ. of Manchester, Eng.). pp 304-307 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Comments are made on three 3-nucleon reactions: radiative nd capture at low energies, quasifree electron proton scattering in three-particle nuclei with ^{3}He as a specific example, and the pion double charge exchange reaction $\pi^- + {}^3\text{He} \rightarrow \pi^+ + 3n$. In the last case it is shown that it is essential to take into account all the nonresonant mechanisms before resorting to an explanation in terms of 3-nucleon resonances. (INIS)

8243 FEW PARTICLE PROBLEMS IN HYPERNUCLEAR PHYSICS. Pniewski, J. (Univ. of Warsaw). pp 145-181 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A review of the current state of knowledge about hypernuclei, in particular few particle problems, is given. The different techniques employed, and the information which they yield, are described, including emulsion techniques, giving binding energies, bubble chambers, for Λp elastic scattering data and counters, for hypernuclear γ-spectroscopy. Various phenomenological approaches to ΛN and ΛNN potentials in s- and p-shell hypernuclei are discussed. Isomeric and excited states are also considered. (INIS)

8244 Λ–Σ COUPLING AND CORE EXCITATION EFFECTS IN THE LIGHT HYPERNUCLEI. Gibson, B. F.; Goldberg, A.; Weiss, M. S. (Univ. of California, Livermore). pp 188-190 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceeding of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

An investigation of the effects on the binding energies of ${}^4_\Lambda$H, ${}^4_\Lambda$He, and ${}^5_\Lambda$He produced by the Λ–Σ coupling was recently reported. The conclusions drawn were: 1) the Λ–Σ coupling produces a significant effect on the binding energies of ${}^4_\Lambda$H and ${}^4_\Lambda$He under the assumption that Λ–Σ coupling is suppressed in the ${}^5_\Lambda$He system (since a core excitation of ${}^4_\Lambda$He to a T = 1 state is required in order to couple with the Σ isotriplet); 2) the difference in the Λ-separation energy for each member of the ${}^4_\Lambda$He–${}^4_\Lambda$He isodoublet results from the admixture of the Σ state, being in part due to Coulomb effects and in part due to the mass splitting within the Σ triplet. No explicit calculations were reported in which the effects of the core excitations in ${}^4_\Lambda$He were included. New results are reported in which the T = 1 excitation of ${}^4_\Lambda$He is considered and which confirm that in fact the Λ–Σ coupling is strongly suppressed in ${}^5_\Lambda$He. The consequences of this for the Λ-separation energy splitting in the ${}^4_\Lambda$H–${}^4_\Lambda$He system are also discussed. (auth)

8245 COMPARISON BETWEEN TWO MODELS FOR THE ISOSPIN DEPENDENCE OF MANY-PARTICLE PRODUCTION CROSS SECTIONS. Fratamico, G. (Istituto Nazionale di Fisica Nucleare, Bologna). Lett. Nuovo Cim.; 9: No. 17, 697-700(27 Apr 1974).

Two simple models for the isotopic-spin dependence of the production amplitudes are discussed with the aim of clarifying some general features of production processes. A simplified picture of proton-proton interactions is adopted, assuming that in the final state one finds two protons and a number n of pions with a vanishing total isotopic spin. (LBS)

8246 HIGH ENERGY COLLISIONS OF HADRONS. Van Hove, L. (CERN, Geneva). pp 130-152 of Developments in High-Energy Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

A summary is given of a lecture series the aim of which was to show by examples that high energy collision data contain a number of interesting features which have hardly been exploited until now, partly because they do not directly relate to predictions or tests of current theoretical models, partly because they are only uncovered by making the effort of analyzing the data in multidimensional phase space. The interactions p + p, π + p, and K + p are discussed including single-particle distributions, correlations, energy dependence, and inclusive and exclusive interactions. (JFP)

8247 CAN THE CHARGE SYMMETRY OF NUCLEAR FORCES BE CONFIRMED BY NUCLEON-NUCLEON SCATTERING EXPERIMENTS? Sauer, P.U. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. Lett. 32: No. 11, 626-630 (18 Mar 1974).

The Coulomb interaction is subtracted from the proton-proton scattering data in the $^1S_0$ partial wave. Contrary to traditional belief, the resulting nuclear effective-range parameters depend strongly on the unknown nuclear potential at small distances. The comparison between proton-proton and neutron-neutron data is therefore ambiguous. (auth)

8248 DISPERSION-THEORETIC APPROACH TO OFF-SHELL T MATRICES. Reiner, M.J. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 32: No. 5, 236-239 (4 Feb 1974).

We present a dispersion-theoretic formalism for obtaining the off-shell t matrix, which allows the possibility of working directly from relativistic meson theory, without the necessity of explicitly using a potential. The formalism is illustrated for two simple models of the two-nucleon interaction. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 8131 and 8584.

8249 (HU-TFT-72-10) CLEBSCH-GORDAN COEFFICIENTS FOR THE POINCARE GROUP. Whippman, M. L. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Apr 1972. 60p. INIS.

All Clebsch-Gordan coefficients for the Poincare group are calculated by a simple global method. The main results needed concerning the representations of the various little groups are summarized. The reduction when one of the little groups is the full Lorentz group is discussed. The volume element for the Poincare group is calculated and a degenerate case of the reduction is treated. (FI)

8250 (HU-TFT-72-26) IS CP VIOLATED IN THE $(3,\bar{3})$ + $(\bar{3},3)$ MODEL OF THE CHIRAL SYMMETRY? Saliu, L. (Helsinki Univ. Finland). Research Inst. for Theoretical Physics). 1972. 10p. INIS.

The existence of CP violation term belonging to the $(3,\bar{3})$ + $(\bar{3},3)$ chiral representations is discussed. A recent comment of Beg about the order-of-magnitude difficulties which should appear in this model is reexamined. (auth)

8251 (TKP-11-73) DIMENSIONS OF THE CHIRAL AND DILATION SYMMETRY BREAKING HAMILTONIAN DENSITIES. Cornwell, D. T.; Genz, H. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Theoretische Kernphysik). May 1973. 15p. ZAED.

Denoting by 1[u] and 1[d] the dimensions of the chiral and dilation symmetry breaking Hamiltonian densities u(x) and d(x), respectively, the property (4-1[u]) (1[u]-1[d]) > 0 (which is already known in special cases) is derived for a much larger class of models. One furthermore obtains a simple and general explicit expression for u(x) in terms of the current divergences, and reviews the physical applications of this (or an analogous, almost obvious) expression. (orig.) (GE)

8252 NEW SELECTION RULES AND SYMMETRY RELATIONS FOR REGGE-REGGE CUTS. Goldstein, G. R. (Tufts Univ., Medford, MA). Nucl. Phys.; B73: No. 1, 109-124(1974).

Using SU(3) and duality constraints, Worden has shown that the Finkelstein cut selection rule requires that all odd signature Regge-Regge cuts are strongly suppressed in meson-baryon scattering. Worden's analysis was extended by constructing the SU(3) coefficients, for the Gribov vertices, that are appropriate for dual resonance models. By combining the coefficients for two Gribov vertices and preserving the Finkelstein rule, a complete set of symmetry relations is obtained. Examples of these relations are that Regge-Regge cuts do not contribute to meson-meson scattering when the external mesons have overall odd C parity, and that the I = 2 part of Δ photoproduction cannot arise from Regge-Regge cuts. (auth)

8253 SYMMETRIES: SOME RECENT THEORETICAL WORK. Henley, E. M. (Univ. of Washington, Seattle). pp 221-245 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Recent theoretical developments in the understanding of quantum mechanical symmetries as they pertain to few particle systems are reviewed. Ideas on space-time symmetries, particularly parity and time reversal invariance, as well as on internal charge symmetries are included. Comments are given on more exotic asymmetries that have been conjectured, particularly for the electromagnetic and weak axial currents. (auth)

8254 ANALYSIS OF THE REPRESENTATIONS OF SYMMETRY GROUPS IN QUANTUM THEORY. Borisov, N. V. Vestn. Leningrad. Univ., Fiz., Khim.; No. 22, 153-154(1973). (In Russian).

8255 DUAL MODELS: THEIR GROUP-THEORETIC STRUCTURE. Alessandrini, V. (Univ., Geneva); Amati, D. pp 58-97 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

Lectures are given on the basic underlying simplicity of dual models due to the existence of a symmetry group — the group of real projective transformations isomorphic to SU(1,1) or SL(2,R) — that guarantees the duality and factorization properties of the amplitudes given by the model. (JFP)

8256 LECTURES ON CHIRAL SYMMETRY BREAKING. Dashen, R. (Princeton Univ., NJ). pp 204-231 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

The discussion of SU(3) × SU(3) breaking covers models of chiral symmetry, chiral symmetry in strong interactions, models of symmetry breaking, the Goldberger-Treiman relations, meson masses, π-π scattering, kaon three-body leptonic decay, π-N scattering, nonleptonic weak interactions, and electromagnetic mysteries. (JFP)

8257 LIGHT CONE AND SYMMETRY BREAKING. Brandt, R. A. (CERN, Geneva). pp 297-322 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

It is shown how the use of light cone techniques together with several physical parameters from the exact operator relations embodied in current algebra and its generalization to the light cone. Current algebra is considered. (JFP)

8258 CONTINUOUS SPINS IN THE BONDI-METZNER-SACHS GROUP OF ASYMPTOTIC SYMMETRY IN GENERAL RELATIVITY. Girardello, L. (International Centre for Theoretical Physics, Trieste, Italy); Parravicini, G. Phys. Rev. Lett. 32: No. 10, 565-568 (11 Mar 1974).

It has been suggested that elementary particles should be associated with the irreducible representations of the Bondi-Metzner-Sachs group, on the grounds that in these, only discrete spins appear. We emphasize

that the last statement strongly depends on the topology originally chosen for supertranslations, and we discuss in some detail how continuous spins appear when other equally reasonable topologies are chosen, which depend in a more explicit way on the smoothness of supertranslations. (auth)

8259 UNITY OF ALL ELEMENTARY-PARTICLE FORCES. Georgi, H.; Glashow, S.L. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 32: No. 8, 438-441 (25 Feb 1974).

Strong, electromagnetic, and weak forces are conjectured to arise from a single fundamental interaction based on the gauge group SU(5). (auth)

8260 PARTICLES OF NONZERO REST MASS AND SPIN ALGEBRAS. Beckers, J.; Pirotte, C. (Service de Physique théorique et mathématique, Université de Liège). Ann. Phys. (N.Y.) 78: No. 1, 258-270 (15 May 1973).

We construct a family of parametrized spin-Z_α algebras from the (canonical) spin-S and (helicity)spin-Z ones in the case of irreducible unitary representations [m,s] of the Poincaré group. The parameter α refers to a rotation angle around the third axis. Equivalences of such constructions are given through a family of unitary transformations containing, for definite values of α, well established and very useful transformations. General formulas referring to the so-called Shirokov–Foldy form of the Poincaré generators and to typical Shirokov's operators are given explicitly. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 6642 and 8184.

Applications (Strong)

Refer also to abstracts 8232 and 8233.

8261 SOME EXPERIMENTAL ASPECTS OF SYMMETRIES. Wilkinson, D. H. (Oxford Univ.). pp 191-220 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Some experimental aspects of symmetries are reported. Among the aspects considered are: charge independence of the NN forces; the isotensor component of the electromagnetic current; parity; time; Fermi and Gamow–Teller β-decay; coupling constant renormalization. (INIS)

8262 SOME FEATURES OF $(3,\bar{3}) \times (\bar{3},3)$ BREAKING OF CHIRAL SYMMETRY. Maiani, L. (Istituto Superiore di Sanita Rome). pp 232-245 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

A lecture is given illustrating some general features of Lagrangian theories of strong interactions where the Lagrangian can be meaningfully separated into two terms: a term symmetrical under the chiral SU(3) × SU(3) group, and a breaking term which is assumed to transform under the same group according to the representation $(3,\bar{3}) + (\bar{3},3)$. It is found that the theory displays a remarkable degree of symmetry and allows some general features of the hadron spectrum to be interpreted in a very simple way. (JFP)

Scattering Theory

Refer also to abstracts 8230, 8376, and 8547.

8263 (JINR-P4-7768) APPROXIMATION METHODS OF INVERSE PROBLEM IN NUCLEAR THEORY. Zakhar'ev, B. N.; Niyazgulov, S. A.; Suz'ko, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Within the framework of finite-difference approximation for Schrodinger equation and short-range forces an "exact" inverse problem is formulated: the reconstructed potential gives the initial scattering parameters without distortion when solving the direct problem. The technique is generalized for complex potentials, for potential with known long-range component as well as for equations describing multichannel processes. It is shown that the inverse problem can be employed for studies of many body systems. (auth)

8264 (KFKI-74-12) ON THE NON-RELATIVISTIC HIGH ENERGY SCATTERING ON SINGULAR POTENTIALS. Dolinszky, T. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

The scattering problem for a potential of singularity r^{-4} is solved in terms of the phase function. The high energy phase shift was found to depend, to a high accuracy, linearly on the symmetry parameter χ of the pure power potentials and the proportionality factor turned out to support the asymptotic exactness of the WKB approximation. Some formulas for the small distance behavior of the phase function are also given. (auth)

8265 ANALYTIC PROPERTIES OF THE BOX DIAGRAM AMPLITUDE. II. Frederiksen, J. S.; Woolcock, W. S. (Australian National Univ., Canberra). Ann. Phys. (N. Y.); 80: No. 1, 86-117(Sep 1973).

A spectral representation is obtained for the box diagram amplitude for both real and complex values of the kinematical invariants s and t. By starting with a particular normal threshold spectral representation obtained previously and analytically continuing in the external masses and then in s and t, the various forms of the spectral representation are obtained for all possible mass configurations involving externally stable particles. In particular, a spectral representation is established for all s in the upper half-complex-plane and for almost all real t. (auth)

8266 BEST REPRESENTATION OF SCATTERING DATA BY ANALYTIC FUNCTIONS IN L_q-NORM WITH POSITIVITY CONSTRAINTS. Caprini, I. (Inst. for Atomic Physics, Bucharest). Nuovo Cim.; 21A: No. 2, 236-248(21 May 1974).

The problem of representing scattering data given on the boundary of the analyticity domain by analytic functions satisfying unitarity is investigated. The optimal representation in L_q-norm is shown to be the solution of a constrained convex optimization problem in some Hilbert space of analytic functions. A duality optimization theorem based on the generalized Lagrange multiplier technique is applied for solving this problem. The method is found to easily accommodate unequal errors on the real and imaginary parts of the amplitude and the case of data given along a limited part of the boundary. (auth)

8267 OFF-MASS SHELL DUAL AMPLITUDES. II. Schwarz, J. H.; Wu, C. C. (California Inst. of Tech., Pasadena). Nucl. Phys.; B72: No. 3, 397-412(1974).

A new method for continuing dual model amplitudes off the mass shell was recently proposed. This paper explores some of the properties of the resulting amplitudes. It is demonstrated that one-current amplitudes contain fixed poles in the J-plane at positions that are correlated with the asymptotic power behavior of form factors. The two-point function is explicitly calculated and shown to fall asymptotically as a power provided that a certain condition involving the dimension of space-time and a parameter (that is believed to be correlated with the leading Regge intercept) is satisfied. Certain formulas required for future investigation of more complicated amplitudes are also derived. (auth)

8268 FUNCTIONS OCCURRING IN DUAL FERMION AMPLITUDES. Schwarz, J. H.; Wu, C. C. (California Inst. of Tech., Pasadena). Nucl. Phys.; B73: No. 1, 77-92(1974).

A new derivation of certain functions occurring in the elastic scattering of fermion ground states in the 10-dimensional dual-resonance model is presented. A more general class of amplitudes in which two fermions scatter inelastically is then discussed, and three new functions that occur in these amplitudes are calculated. The results appear to indicate that the inelastic amplitudes are also well-behaved. (auth)

8269 SCATTERING THEORY IN A TIME-DEPENDENT EXTERNAL FIELD. II. Applications. Prugovecki, E. (Univ. of Toronto); Tip, A. J. Phys., A (London); 7: No. 5, 586-596 (21 Mar 1974).

The general theory of the scattering of two particles in a time-dependent external field, presented elsewhere (Prugovecki and Tip. J. Phys. A. Math. Nucl. Gen.; 7:572-85 (1974)) is applied to the case of two point particles with internal structure which interact through a potential with matrix representation $(V_{kl}(r))$. Under suitable, quite general, conditions upon the l^2 operator bound $|V(r)|$ of $(V_{kl}(r))$ the existence of the wave operators $\Omega_\pm(s)$ is proven for two field configurations. The first is that of a spatially homogeneous time-dependent field, whereas in the second case the field is inhomogeneous but localized in space. Some attention is paid to the problem of the existence of differential cross sections and their relation to the scattering operator $S(s) = \Omega_+^\dagger(s)\Omega_-(s)$. (auth)

8270 VENEZIANO AMPLITUDES, ANGULAR-MOMENTUM COEFFICIENTS, AND RELATED SYMMETRIES. Regge, T. (Univ., Turin). pp 111-116 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

A lecture is given illustrating some interesting properties of the Veneziano amplitudes and their connection with the well known Clebsch–Gordan and Racah coefficients useful in the theory of angular momentum. (JFP)

8271 POLARIZATION PHENOMENA AS A TEST FOR THE MODEL OF CUTS GENERATION. Macek, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 22: No. 2, 165-169(Feb 1974).

It is shown that the behavior of scattering amplitudes f(n) (in the impact parameter representation) with the definite total helicity flip n (n ≥ 2) can be investigated by measuring certain polarization quantities. The calculations are compared with the weak cuts model and the strong absorptive cuts model. (auth)

8272 ALTERNATIVE SET OF OPERATORS FOR THREE-PARTICLE SCATTERING. Karlsson, B. R.; Zeiger, E. M. (Stanford Linear Accelerator Center, CA). pp 330-333 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A set of operators intermediate between the more conventional Faddeev $M_{\beta\alpha}$ and Lovelace-type $U_{\beta\alpha}$ operators is presented. Although introduced already more or less explicitly by a number of authors, this set is shown to combine attractive features of both $M_{\beta\alpha}$ and $U_{\beta\alpha}$, and to be the most natural one to consider when starting from a wave function approach. (auth)

8273 THE THREE-PARTICLE S MATRIX. Newton, R.G. (Department of Physics, Indiana University, Bloomington, Indiana 47401). J. Math. Phys. (N.Y.) 15: No. 3, 338-343 (Mar 1974).

It is proven that a reduced T matrix, defined by factoring out of the three-particle S matrix the product of the three two-particle S matrices, is a compact operator on the energy shell, in spite of the double-scattering singularity. As a result there exists a discrete, complete set of eigenphase shifts at every energy. (auth)

8274 FADDEEV-LIKE EQUATIONS WITH MULTIBODY FORCES. Gregorio, M.A.; Avalos, D.R. (International Centre for Theoretical Physics, Trieste, Italy). J. Math. Phys. (N.Y.) 15: No. 3, 367-373 (Mar 1974).

Equations for a system of four particles interacting through two-, three-, and four-body potentials are derived using a generalization of Faddeev's technique for the three-body problem. Two alternative approaches are considered and simple equations for iterative solutions are written down. The method is generalized to the N-body problem with multibody forces. (auth)

8275 ANGULAR MOMENTUM REDUCTION FOR PHYSICAL AMPLITUDES IN THE THREE-BODY PROBLEM. Bollé, D.; Osborn, T.A. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. C 9: No. 2, 441-459 (Feb 1974).

We give here an approach to the angular momentum reduction that is tailored to be appropriate for the multichannel structure of the three-body problem. Wherever possible we work directly with the physical scattering amplitudes. We obtain concrete partial-wave expansions of elastic, rearrangement, and breakup amplitudes. For these amplitudes we obtain a coupled two-variable integral equation. The effects of parity, time reversal, and rotational invariance are fully discussed. Finally, we provide expressions for the multichannel partial-wave cross sections, asymptotic coordinate-space wave functions, off-shell unitarity, and the partial-wave version of the optical theorem as well as phase-shift parametrizations of the amplitudes. (auth)

8276 DESCRIPTION OF MULTIPARTICLE PHASE SPACE IN INVARIANT VARIABLES. Byckling, E.; Whippman, M.L. (Research Institute for Theoretical Physics, University of Helsinki, Helsinki 17, Finland). Ann. Phys. (N.Y.) 81: No. 1, 49-66 (Nov 1973).

A new set of invariant variables is introduced to describe a process with n particles in the final state. The invariant phase space density is calculated in terms of these invariants and in terms of the usual invariant scalar products of pairs of four vectors. The new invariants include variables which treat all n particles symmetrically and which are very simply related to the boundary curves for the physical region, and a further set which describe rotations in an n-dimensional space. Possible applications to the description of high energy data are discussed. (auth)

8277 STILL ANOTHER METHOD FOR PHASE-SHIFT COMPUTATION. Bolsterli, M. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. Lett. 32: No. 8, 436-437 (25 Feb 1974).

A new method for computing phase shifts is presented. It is based on solving a nonsingular integral equation for the momentum-space wave function. In a sample case it is more accurate than other methods. (auth)

8278 LOWER BOUNDS ON CROSS SECTIONS WITHOUT UNKNOWN CONSTANTS AND VALID AT ALL ENERGIES. López, C.; Ynduráin, F.J. (Departamento de Física–C-XI, Universidad Autónoma de Madrid, Canto Blanco, Madrid, Spain). Ann. Phys. (N.Y.) 82: No. 2, 482-500 (Feb 1974).

We obtain lower bounds for cross sections (total and differential) which are of the form of integral constraints, and which contain no unknown constants and that are valid at finite energies (and not only asymptotically). The information that we use to obtain the bounds may be of three different types (giving three different kinds of bounds): a few low energy parameters; a few low energy parameters plus experimental information on a given wave (the D wave); or one unphysical parameter that may be obtained from other sources (field theoretical calculations with soft pion techniques). The comparison of the bounds with experiment is also discussed. (auth)

8279 S-WAVE INVERSE PROBLEM AND SUM RULES FOR POTENTIALS WITH A SIMPLE POLE AT THE ORIGIN. Degasperis, A. (Istituto di Fisica dell'Universita' di Lecce, Via Arnesano I-73100 LECCE—Italy). Ann. Phys. (N.Y.) 81: No. 2, 519-566 (Dec 1973).

In a previous paper (F. Calogero and A. Degasperis, J. Math. Phys. 9 (1968), 90) an approach to the inverse problem for the nonrelativistic S-wave potential scattering has been developed with the aim of obtaining explicit and exact expressions of the potential in terms of the phase shift and of the bound states parameters. Since this method, based on the high energy asymptotic expansion, yields the expression of the potential and of all its derivative at the origin only if these quantities are bounded, physically interesting interactions such as the Yukawa potential could not be considered. In this paper this approach has been generalized to potentials with a simple pole at the origin and the expression of the Laurent coefficients of the potential in a neighborhood of the origin has been obtained as an explicit functional of the experimental data. Furthermore the general structure of the high energy expansion of the phase shift has been derived and discussed. The requirement that the potential has only a simple pole at the origin turns out to imply strong constraints on the experimental data. These conditions on the experimental data have been explicitly expressed as a set of infinitely many nonlinear sum rules involving only the phase shift and the energies of the bound states. (auth)

8280 EIKONAL EXPANSION. Wallace, S.J. (Department of Physics, University of Washington, Seattle, Washington 91805). Ann. Phys. (N.Y.) 78: No. 1, 190-257 (15 May 1973).

An eikonal expansion of the potential scattering T matrix is evaluated, without approximation, through third order in the inverse momentum. Based on the results, their correspondence with the WKB approximation and a new statement of the unitarity constraint, we propose a sequence of four approximations to the exact impact parameter (Fourier–Bessel) representation of the scattering matrix. The sequence consists of the Glauber approximation and three systematic corrections to the Glauber approximation. The corrections are analytic functions of the impact parameter for Yukawa and Gaussian potentials; they vanish for a Coulomb potential. The sequence of eikonal amplitudes is convergent at high energy and is clearly established for small momentum transfer. Validity for all momentum transfer is conjectured based on systematic cancellation, explicitly verified through third order in the expansion, of momentum transfer dependence in the eikonal impact parameter representation. Such cancellation is shown to occur in the explicit construction of the eikonal expansion of the second Born amplitude for a Yukawa potential. Numerical tests of the sequence of eikonal amplitudes show systematic increase of the angular range of validity by comparison with partial wave results for continuous potentials; the theory is not convergent for discontinuous potentials. The WKB phase shift formula is shown to produce a systematic connection with eikonal expansion results. From this we deduce a generating function for the eikonal phase corrections of arbitrary order and also conjecture a sum of the eikonal expansion valid in the limit of high energy and arbitrary potential strength. (auth)

8281 OFF-ENERGY-SHELL EFFECTS IN MULTIPLE SCATTERING. Kujawski, E. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Lambert, E. Ann. Phys. (N.Y.) 81: No. 2, 591-624 (Dec 1973).

The elastic scattering from a two-body bound system is investigated in order to determine what information about the nuclear structure and the projectile-nucleon interaction may be obtained at intermediate energies. Emphasis is placed on the kinematics and the importance of properly treating the overlapping potential region. The kinematics of the "fixed scatterer" and "impulse" approximations result in differences which are still significant at intermediate energies. As far as scattering information is concerned, the overlapping potential region is the interesting one since it requires explicit knowledge of the interaction.

Our results suggest that for nucleon scattering at intermediate energies the corrections due to properly taking into account off-energy-shell effects are likely to be comparable with the contributions due to the short-range two-body correlations. The relevance of the above results to various models currently employed in analyzing high- and intermediate-energy nuclear scattering is also discussed. (auth)

8282 NEW L^2 APPROACH TO QUANTUM SCATTERING: THEORY. Heller, E.J. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138); Yamani, H.A. Phys. Rev. A 9: No. 3, 1201-1208 (Mar 1974).

By exploiting the soluble infinite tridiagonal (Jacobi) -matrix problem generated by evaluating a zeroth-order scattering Hamiltonian H_0 in a certain L^2 basis set, we obtain phase shifts, wave functions, etc., which are exact for a full Hamiltonian H in which only the potential V is approximated. Only bound-bound (L^2) matrix elements of the Hamiltonian and finite matrix manipulations are needed. The method is worked out here for s-wave scattering using Laguerre basis functions. Kato improvement of the results and necessary generalizations to many channels are treated. (auth)

8283 EXPANSIONS IN BREIT-WIGNER AMPLITUDES AND BIORTHOGONAL FUNCTIONS. Klink, W.H. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52240). J. Math. Phys. (N.Y.) 15: No. 5, 565-569 (May 1974).

The problem of finding the expansion coefficients for a finite superposition of Breit-Wigner amplitudes is dicussed. Since such amplitudes are not mutually orthogonal, another set of functions orthogonal to the Breit-Wigner functions are computed. Advantages and disadvantages of this biorthogonal set of functions are compared with conventional orthogonal functions and, in particular, the problem of reading off expansion coefficients when the modulus squared of the amplitude is known—rather than the amplitude itself—is discussed. (auth)

8284 ANALYTICITY IN THE COUPLING STRENGTH. Graves-Morris, P.R.; Rennison, J.F. (Mathematical Institute, University of Kent, Canterbury, England). J. Math. Phys. (N.Y.) 15: No. 2, 230-233 (Feb 1974).

We briefly review the methods which have been used to establish the domains of analyticity of the partial wave scattering amplitude in the presence of a Yukawa potential as a function of the coupling strength, and the methods available for proving the convergence of Padé approximants to the Neumann series of the partial wave Lippman-Schwinger equation. We then give a complete proof, using the Banach space technique first used by Lovelace, that the scattering amplitude is meromorphic in the coupling strength, and use Pommerenke's or Beardon's theorem to deduce the domains of convergence of the Padé approximants. (auth)

8285 ON THE EXISTENCE OF SOLUTIONS TO S MATRIX MODELS. Greenman, J.V. (Research Institute for Theoretical Physics, University of Helsinki, Siltavuorenpenger 20B Helsinki 17, Finland). J. Math. Phys. (N.Y.) 15: No. 4, 502-507 (Apr 1974).

We analyze the charged scalar Low equation and show that, in this case at least, the breakdown of the standard fixed point theorems occurs because of their inherent weakness rather than through some topological change in the structure of the family of solutions. We also show that unless we reformulate the equation the Schauder principle only handles the basic solution, that solution without CDD poles. We discuss methods, alternative to the N/D method, to handle the other solutions. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

8286 INFORMAL TALK ON LIQUID HELIUM. Regge, T. (Univ., Turin). pp 423-426 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

Some of the properties and problems of helium II are discussed. It is suggested that helium II should be regarded as a particular model of field theory in which one may vary to some extent the relevant parameters and gain useful information. (JFP)

8287 VORTEX RING NUCLEATION RATE DUE TO NEGATIVE IONS TRAVELLING NEAR THE LANDAU VELOCITY IN He II. Phillips, A.; McClintock, P. V. E. (Lancaster Univ., Eng.). J. Phys., C (London); 7: No. 7, L118-L119(7 Apr 1974).

Field emission characteristics in He II at temperatures $0.3 < T < 0.8$ K and under pressures $10 < P < 25$ bar have been used to deduce values of the vortex ring nucleation rate ν in electric fields $\epsilon \sim 3$ kV cm^{-1}. The values of ν obtained are an order of magnitude larger than those recently determined by Zoll and Schwarz (Phys. Rev. Lett.; 31: 1440 (1973)), who employed a completely different technique at the same T and P but with $\epsilon \sim 20$ V cm^{-1}. (auth)

8288 HYDRODYNAMICS OF SUPERFLUID HELIUM BELOW 0.6 °K. III. PROPAGATION OF TEMPERATURE WAVES. Maris, H.J. (School of Mathematics and Physics, University of East Anglia, Norwich, England). Phys. Rev. A 9: No. 3, 1412-1426 (Mar 1974).

The propagation of second-sound waves in superfluid helium is considered for temperatures below 0.6 °K. A dispersion relation for the waves is obtained. This relation is valid for frequencies much less than the small-angle phonon-phonon collision rate. In the low-frequency limit the usual second-sound mode with velocity $c_0/\sqrt{3}$ is found (c_0 is the phonon velocity). At higher frequencies the velocity of this mode increases towards c_0, and other modes of lower velocity appear. The nature of these waves is discussed. Finally, several experiments that might give information about the waves are considered. (auth)

8289 DYNAMICAL SPIN SUSCEPTIBILITY OF THE ANDERSON-MOREL STATE IN SUPERFLUID He^3. Maki, K. (Department of Physics, Tohoku University, Sendai, Japan); Ebisawa, H. Phys. Rev. Lett. 32: No. 10, 520-523 (11 Mar 1974).

Making use of a model Hamiltonian which includes, in addition to the pairing interaction, the spin-exchange interaction as well as the dipole interaction, we calculate explicitly the dynamical spin susceptibility of the Anderson-Morel state. It is shown within the random-phase approximation that the spin susceptibility has simple poles, which give rise to the nuclear magnetic resonance in liquid ^{3}He. The result is compared with a recent phenomenological theory by Leggett. (auth)

8290 ANOMALOUS BEHAVIOR OF THE KAPITZA RESISTANCE BETWEEN SOLIDS AND LIQUID HELIUM II. Cheeke, J.D.N.; Hebral, B.; Richard, J.; Turkington, R.R. (Centre de Recherches sur les Très Basses Températures, Centre National de la Recherche Scientifique, 38042 Grenoble, France). Phys. Rev. Lett. 32: No. 12, 658-661 (25 Mar 1974).

We report observations of an anomalous behavior in the Kapitza resistance between Cu or Pb and liquid helium II in the range 1-2 K. Systematic deviations from linearity at small heat fluxes have been observed for the temperature difference as a function of heat current. The dependence of the anomaly upon diameter and temperature is described, as well as possible origins of the effect. (auth)

8291 LONGITUDINAL RESONANCE AND DOMAIN EFFECTS IN THE A AND B PHASES OF LIQUID HELIUM THREE. Osheroff, D.D.; Brinkman, W.F. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. Lett. 32: No. 11, 584-587 (18 Mar 1974).

We report measurements of the longitudinal NMR resonance in the A phase of liquid He^3 on the melting curve below 2.7 mK, and show them to be consistent with that phase being the state proposed by Anderson and Brinkman. Strong field dependence of the B-liquid transverse NMR line shape, including the existence of a broad high-frequency tail, is presented and interpreted as domain effects in a Balian-Werthamer state. Absorption in the longitudinal mode in the B phase is also reported. (auth)

8292 THICKNESS OF THE MOVING SUPERFLUID FILM AT TEMPERATURES BELOW 1 °K. Williams, G.A.; Packard, R.E. (University of California, Berkeley, California 94720). Phys. Rev. Lett. 32: No. 11, 587-590 (18 Mar 1974).

The thickness of a flowing He II film has been measured at temperatures below 1 °K. The film's thickness varies quadratically with the flow velocity, in agreement with theory. The implications of this observation are discussed with regard to similar measurements performed at higher temperatures. (auth)

8293 IS THE ONSET OF SUPERFLUIDITY CONNECTED TO "CONNECTIVITY"?. Chester, M. (School of Mathematical and Physical Sciences, University of Sussex, Falmer, Brighton, England); Yang, L.C. Phys. Rev. A 9: No. 3, 1475-1478 (Mar 1974).

As their explanation for the relatively precipitous onset of superfluidity in thin helium films which we have reported, Dash and Herb have recently advanced their "connectivity" theory. An analysis of this theory is presented here and some predictions are deduced from it. These predictions appear to be in contradiction to the experimental facts. Hence, the theory seems inapplicable to the onset phenomena reported. (auth)

8294 NMR FREQUENCY IN THE SUPERFLUID PHASES OF ^{3}He. Varma, C.M.; Werthamer, N.R. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. A 9: No. 3, 1465-1467 (Mar 1974).

All unitary solutions of the weak-coupling gap equation for $l=1$ pairing are exhibited, and their rotational degeneracies highlighted. The role of the Zeeman and dipolar energies in resolving these degeneracies is examined. These interactions are used to calculate the NMR frequency and the assumptions used by Anderson and by Leggett in earlier calculations are clarified. In particular "classical" equations are given which are equivalent to Leggett's quantum-mechanical analysis. (auth)

8295 SUPERFLUID HELIUM FILM BELOW 1 K: THICKNESS, FLOW RATE, AND INFLUENCE OF He^3. Crum, D.B.; Edwards, D.O.; Sarwinski, R.E. (Physics Department, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. A 9: No. 3, 1312-1318 (Mar 1974).

The superfluid helium film flow rate and the film profile (thickness versus height) on polished stainless steel have been measured in the same series of experiments down to 0.03 K. The concentration of He^3 was varied from that of nominally "pure" He^4(~0.2 ppm) to 0.44% He^3. The film profile was measured below 0.7 K by observing isothermal flow oscillations. Apart from a small hysteresis effect, it agrees with the simple Frenkel-Schiff theory using the van der Waals potential calculated from the Lifshitz equation. In agreement with theory, the profile is not changed by small concentrations of He^3 (up to a few hundred ppm) which, however, significantly decrease the superfluid flow rate below 1 K. The effect of of the He^3 on the flow rate is most striking below 0.5 K, where surface-tension measurements have shown that the He^3 is partially adsorbed on the surface of the He^4, lowering the surface tension. In this region the flow rate is observed to be approximately proportional to the square root of the surface tension as predicted by Arkhipov. With a larger amount of He^3 (0.44%) the flow rate below 0.1 K increases quite rapidly with decreasing temperature. The increase is apparently connected with the beginning of Fermi degeneracy in the He^3 dissolved in the film. Some observations of the flow rate for very small level differences are also reported. (auth)

8296 INFLUENCE OF PHONON DISPERSION ON THE VELOCITY OF SECOND SOUND IN He II. Brooks, J.S.; Donnelly, R.J. (Department of Physics and Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). Phys. Rev. A 9: No. 3, 1444-1445 (Mar 1974).

We present calculations of the velocity of second sound u_2 below 1 K as a function of pressure. These calculations show that u_2 rises above the Landau limit in the presence of positive phonon dispersion. The effect should be experimentally observable in a suitably designed apparatus. (auth)

8297 CORRELATION LENGTH, FINITE-GEOMETRY EFFECTS, AND UNIVERSALITY IN PRESSURIZED SUPERFLUID HELIUM NEAR T_λ. Ihas, G.G.; Pobell, F. (Institut für Festkörperforschung, Kernforschungsanlage, 517 Jülich, West Germany). Phys. Rev. A 9: No. 3, 1278-1296 (Mar 1974).

The onset temperature $T_0(P)$ for superfluidity of ^{4}He has been measured in d = 0.1-, 0.2-, 0.4-, and 0.6-μm wide channels at pressures between saturated vapor pressure and the melting curve. The onset was detected by observing the vanishing of second sound in resonators equipped with superleak transducers. In the channels used the onset temperature $T_0(P)$ was depressed below the bulk transition temperature $T_\lambda(P)$ by $2 \times 10^{-5} \leq \epsilon_0 \leq 2 \times 10^{-4}$. Here $\epsilon_0 = 1 - T_0(P)/T_\lambda(P)$. For constant d, we find that ϵ_0 is independent of pressure

to within our resolution of ±2%. From the data the exponent λ′ and the coefficient d* for the equation $\epsilon_0 = (d/d^*)^{-\lambda'}$, and the exponent and coefficient for the correlation length, $\xi = \xi^* \epsilon^{-\nu'}$, have been calculated. We show that λ′ and d*, as well as ν′ and ξ*, and the quantity $\xi\rho_s/T$ are independent of pressure, within our resolution of ±2%. The lack of a pressure dependence of the critical exponents is in agreement with universality arguments. For the absolute values we find $\xi = (1.2 \pm 0.1) \times 10^{-8}\epsilon^{-0.45\pm0.02}$, $\epsilon_0 = [d/(5.7 \pm 0.6) \times 10^{-8}]^{-1.54\pm0.05}$, and $\xi\rho_s/T = (0.16 \pm 0.01) \times 10^{-8}$. (auth)

8298 PROPAGATION OF SOUND IN TWO-DIMENSIONAL He^3. Eckardt, J.R.; Edwards, D.O.; Fatouros, P.P.; Gasparini, F.M.; Shen, S.Y. (Department of Physics, Ohio State University, Columbus, Ohio 43210). Phys. Rev. Lett. 32: No. 13, 706-709 (1 Apr 1974).

"Surface sound" has been observed for the first time, in He^3 adsorbed on the free surface of liquid He^4. Measurements of the surface-sound velocity and surface tension are used to obtain new values for the effective mass M = (1.3 ± 0.1)m_3 and binding energy ϵ_0/k_B = 2.28 ± 0.03 K of the adsorbed He^3. (auth)

8299 PROPAGATION OF FOURTH SOUND IN SUPERFLUID ^{3}He. Kojima, H.; Paulson, D.N.; Wheatley, J.C. (Department of Physics, University of California at San Diego, La Jolla, California 92037). Phys. Rev. Lett. 32: No. 4, 141-144 (28 Jan 1974).

Pressure waves propagate through a superleak in both ^{3}He-A and ^{3}He-B, showing that both are superfluids below T_c. Superfluid relative density is obtained from velocity measurements over a wide pressure range above and below the polycritical point. (auth)

8300 MASS DIFFUSIVITY OF ^{3}He-^{4}He MIXTURES NEAR THE SUPERFLUID TRANSITION. Ahlers, G. (Institut für Festkörperforschung, Kernforschungsanlage, 517 Jülich, Germany and Bell Telephone Laboratories, Murray Hill, New Jersey 07974); Pobell, F. Phys. Rev. Lett. 32: No. 4, 144-147 (28 Jan 1974).

We report on measurements of relaxation times for the decay of isothermal concentration gradients in ^{3}He-^{4}He mixtures over the temperature range $10^{-5} \lesssim |\epsilon| \equiv |T/T_\lambda - 1| \lesssim 10^{-2}$. The data yield a mass diffusivity D which diverges when T_λ is approached from higher temperatures. When fitted with $D \propto \epsilon^{-z}$, they give z = 0.40, 0.36, and 0.33 for ^{3}He concentrations 0.100, 0.208, and 0.399, respectively. The estimated uncertainty for z is ±0.06. These results are consistent with theoretical predictions, but differ from experimental results by others. (auth)

8301 THIRD SOUND AND THE HEALING LENGTH OF He II IN FILMS AS THIN AS 2.1 ATOMIC LAYERS. Scholtz, J.H.; McLean, E.O.; Rudnick, I. (University of California, Los Angeles, California 90024). Phys. Rev. Lett. 32: No. 4, 147-151 (28 Jan 1974).

Measurements of the velocity of third sound on films as thin as 2.1 atomic layers yield the healing length of superfluid He II down to temperatures of 0.1 K. It is argued that these films are two-dimensional superfluids. (auth)

8302 POLARIZATION MODES IN SUPERFLUID HELIUM. Bagchi, A.; Ruvalds, J. (The James Franck Institute and The Department of Physics, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. Lett. 32: No. 5, 209-212 (4 Feb 1974).

The existence of polarization modes formed by light coupling to pairs of elementary excitations in liquid helium is suggested on theoretical grounds. The mode coupling is calculated by considering the atomic polarization associated with density fluctuations of two quasiparticles with small total momentum. The mode interactions involve the induced dipole moment of helium atoms and can be enhanced by an external field. The polarization modes may be observable in Raman scattering experiments. (auth)

Superconductivity

Refer also to abstracts 7344 and 7366.

8303 (CALT-822-60) SUPERCONDUCTIVITY IN METASTABLE SIMPLE CUBIC ALLOYS. Johnson, W. L.; Poon, S. J. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Mar 1974. Contract AT(04-3)-822. 11p. Dep. NTIS $4.00.

Results of resistivity measurements and x-ray studies of four new metastable simple cubic superconducting alloys are presented. It is shown that in general, superconducting phases with simple cubic structure obey the same valency rules as the A-15 compounds. Common features, including the existence of orthogonal chains of atoms for these two crystalline phases, are discussed in conjunction with superconductivity. (auth)

8304 EFFECTS OF NEUTRON IRRADIATION ON THE SUPERCONDUCTING PROPERTIES OF NbTi AND Nb_3Sn MULTIFILAMENTARY COMPOSITES. Parkin, D. M.; Schweitzer, D. G. (Brookhaven National Lab., Upton, NY). Nucl. Technol.; 22: No. 1, 108-114(Apr 1974).

Multifilamentary composite wires of NbTi and Nb_3Sn were irradiated at 60 ± 5°C with fast neutrons to fluences of 6×10^{19} n/cm². Measurements of the superconducting critical current, I_c, as a function of transverse field show that the NbTi wires are only moderately affected by neutron irradiation. At a fluence of 6×10^{19} n/cm², I_c (40 kG) is 82% of the unirradiated value. The Nb_3Sn composites undergo a catastrophic reduction in I_c with an apparent threshold at a fluence of 2 to 3×10^{18} n/cm². Between 2 to 3×10^{18} and 1.1×10^{19} n/cm², I_c (40 kG) has been reduced to 4% of the unirradiated value. At a fluence of 6×10^{19} n/cm², the upper critical field of Nb_3Sn has been reduced from 240 kG to 9 ± 0.5 kG. The corresponding T_c has been decreased from 16.4 to 6°K. Annealing of Nb_3Sn samples irradiated to 1.1×10^{19} n/cm² produces only 10% recovery in I_c after ½ h at 400°C. (auth)

8305 CRITICAL CURRENTS DUE TO FLUX PINNING IN CYLINDERS OF TYPE I SUPERCONDUCTOR (Pb–Ag). Melville, P. H.; Schlump, W.; Schultz, L. (Univ., Goettingen, Ger.). Solid State Commun.; 14: No. 8, 753-755(15 Apr 1974).

Some preliminary studies of flux pinning in cylinders of Type I superconductors are reported (12 μ silver powder in lead). These show that when a magnetic field appreciably greater than ½ H_c is applied perpendicular to the sample axis, the critical current densities are fairly small (e.g., 5.5×10^6 Am^{-2} at ¾ H_c), but are of the same order that might be expected in a low κ type II superconductor with similar pinning, and that the critical current density is directly proportional to the density of pinning centres in the material, surface currents playing no important role. (auth)

8306 COHERENT PROPERTIES OF A MACROSCOPIC WEAKLY-LINKED SUPERCONDUCTOR. Saxena, A. M.; Crow, J. E.; Strongin, M. (Brookhaven National Lab., Upton, NY). Solid State Commun.; 14: No. 9, 799-802(1 May 1974).

A macroscopic weakly linked superconductor has been constructed by compacting aluminum particles which have oxide coatings. The system forms an array of weakly linked junctions and it appears that the whole system behaves in a cooperative fashion when rf radiation is incident on the sample. (auth)

8307 EFFECT OF LATTICE ANHARMONICITY ON SUPERCONDUCTIVITY. Hui, J. C. K.; Allen, P. B. (Cambridge Univ., Eng.). J. Phys., F (London); 4: No. 3, L42-L45(Mar 1974).

Simple one dimensional models of anharmonic lattice potentials are used to investigate the effect of anharmonicity on the electron–phonon coupling constant λ. It is found that if the phonon energy is interpreted as the first excitation energy then anharmonicity will have little influence except to diminish slightly the size of λ. (auth)

8308 DEFORMING OF THE VORTEX LATTICE BY ALTERNATING CURRENTS. Thorel, P. (Institut Max von Laue, Grenoble, France); Kahn, R. Rev. Phys. Appl.; 8: No. 4, 417-429 (Dec 1973). (In French).

From 3rd meeting on superconducting materials and applications of superconductivity; Aussois, France (4 Apr 1973).

Neutron diffraction was used to study the variations in the properties of a vortex crystal created in superconducting niobium by the application of ac currents (5.10^{-3} Hz to 100 Hz). (FR)

8309 APPLICATION OF THE TIME DEPENDENT LANDAU–GINSBURG EQUATIONS. Anisotropy in the Surface Impedance of Dirty Type II Superconductors. Monceau, P. (CNRS, Grenoble, France); Waysand, G. Rev. Phys. Appl.; 8: No. 4, 413-415(Dec 1973). (In French).

From 3rd Aussois meeting on superconducting materials and applications of superconductivity; Aussois, France (4 Apr 1973).

The dispersion in the experimental results on the anisotropy of the surface impedance of dirty type-II superconductors is attributed to the existence of tilted vortices in the surface sheath. (FR)

8310 SOME NEW ASPECTS CONCERNING THE CRITICAL CURRENTS IN SUPERCONDUCTORS WITH RIGIDLY PINNED VORTEX LATTICE. Takacs, S. (Electrotechnical Inst., Bratislava). Czech. J. Phys.; 24: No. 4, 457-462(1974).

Taking into account the changes of the distribution function of normal excitations in the energy gap of the superconductor and the changes of the "kinetic" energy of superconducting electrons under the influence of an electric current, the basic assumptions and the applicability of the critical-velocity model for the rigidly pinned vortex lattice were reexamined. The same magnetic-field and temperature dependence of the critical current density has been obtained, but without any assumptions about the field dependence of the density of superconducting electrons. The right value of the characteristic length λ is obtained, allowing thus also the

quantitative comparison with the experiments. The new model is applicable for all magnetic fields, in the contradistinction to the narrow validity range of the initial model in the immediate vicinity of the upper critical field H_{c2}. From the many objections concerning the initial model there remained only one, namely, whether the elastic properties of the rigidly pinned vortex lattice can be completely ignored when calculating the critical current. (auth)

8311 GEOMETRICAL EFFECTS IN THE THERMODYNAMICS OF THE TRANSITION BETWEEN THE DIAMAGNETIC STATE AND THE INTERMEDIATE STATE IN SUPERCONDUCTORS OF THE 1ST KIND. Fortini, A.; Paumier, E.; Provost, J.; Girard, J. P. (Caen Univ., France). Rev. Phys. Appl.; 8: No. 4, 427-431(Dec 1973). (In French).

From 3rd meeting on superconducting materials and applications of superconductivity; Aussois, France (4 Apr 1973).

It is shown that the field corresponding to the transition of a type-I superconducting disk into the intermediate state can be determined from the migration of normal domains towards the center. This field exceeds that for which the existence of central domains would be energetically favorable. The persistence of the diamagnetic state beyond the latter field can thus be interpreted by the existence of energy barriers dependent on the shape of the sample. Experimental studies of the magnetization of Pb disks confirmed this process. (FR)

8312 BAND-STRUCTURE EFFECTS ON SUPERCONDUCTIVITY IN DILUTE In–Cd ALLOYS. Kaehn, H.D.; Higgins, R.J. (Department of Physics, University of Oregon, Eugene, Oregon 97403). Phys. Rev. B 9: No. 3, 918-931 (1 Feb 1974).

Data for the pressure and strain derivatives of the superconducting transition temperature show a nonlinear dependence on the impurity concentration in dilute alloys of indium. Results are presented of a calculation for the contribution to these effects of a change in alloy–Fermi-surface topology. The model predicts that these contributions are proportional to the derivatives of the local Fermi energy E_F–E_c (rather than just the derivative of the Fermi energy E_F), and that band-structure effects are important. The model also predicts a nonlinear contribution to T_c as a function of impurity concentration. Energy-band calculations show that the Fermi surface comes closest to a band edge (hence a topology change) in the region where the third-zone β arms connect. This region is investigated using a four-orthogonalized-plane-wave model including spin-orbit coupling. The change in the local Fermi energy with cadmium impurities is calculated. The influence of pressure on the third-band energy minimum E_c in this region is calculated. Estimates are also made for the strain case. The calculated contributions to T_c, dT_c/dP, and $dT_c/d\epsilon$ for the alloys agree well with the shapes observed experimentally but overestimate the magnitudes by a factor of 3. (auth)

8313 FLUCTUATIONS AND THE RESISTIVE TRANSITION IN PARAMAGNETICALLY LIMITED SUPERCONDUCTORS. Aoi, K. (Institut Max von Laue–Paul Langevin, 8046 Garching bei München, Germany); Meservey, R.; Tedrow, P.M. Phys. Rev. B 9: No. 3, 875-887 (1 Feb 1974).

We have studied, both theoretically and experimentally, the extra conductivity σ_n due to thermal fluctuations in high-field superconductors in the Pauli-paramagnetic limit (SPPL). We first investigate theoretically the Aslamazov-Larkin (AL) term, and show that the Pauli-paramagnetic effect in the AL term can be included by renormalizing the thickness of the film. Then we calculate the pair-breaking function for the Maki-Thompson (MT) term in a magnetic field within the lowest-order approximation of Keller and Korenman and show that in contrast to ordinary superconductors the MT term in SPPL can be enhanced by a weak parallel field. We also report the first experimental measurements of σ_n in SPPL. The angular dependence of the AL term is found to be essentially in agreement with the calculation of Aoi reported earlier. Near T_{c0} the MT term is observed to be suppressed by a parallel field. We also study the effect of a perpendicular field, and find, both theoretically and experimentally, that in SPPL the MT term appears to be suppressed by a perpendicular field. (auth)

8314 EFFECTS OF INTERSTITIAL OXYGEN ON THE SUPERCONDUCTIVITY OF NIOBIUM. Koch, C.C.; Scarbrough, J.O.; Kroeger, D.M. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. B 9: No. 3, 888-897 (1 Feb 1974).

Superconductivity in niobium–oxygen body-centered-cubic solid-solution alloys (oxygen content 0.024–3.50 at.%) was studied by calorimetric, magnetic, and resistive measurement techniques. These measurements included low-temperature-specific-heat capacity, superconducting-normal transition temperature T_c, direct-current magnetization, and electrical resistivity, as well as x-ray lattice parameter, microhardness, and optical metallography to characterize the samples. Oxygen in solid solution lowers the T_c of niobium. In contrast to the prediction of DeSorbo, we found that γ, the electronic coefficient of low-temperature-specific-heat capacity, also decreases with oxygen concentration. Our data indicated that the "band-structure" electronic density of states at the Fermi level $N_{ss}(0)$ and the electron–phonon coupling constant λ both decrease with oxygen content. Therefore, both the density of electronic states and the phonon spectrum may be controlling the magnitude of T_c in the niobium–oxygen system. Additional superconducting parameters were calculated for the niobium-oxygen alloys from our calorimetric, magnetic, and resistive data. The Ginsburg–Landau parameter K_{gl} was found to increase from less than 1.0 for essentially pure Nb to about 10 for the Nb–3.5-at.%-O. alloy. Calculated values of H_{c2} (4.2 K) versus atomic-percent oxygen exhibit a maximum at 2-at.% oxygen which was observed experimentally. (auth)

8315 INFLUENCE OF ELECTRONIC LIFETIME ON THE LATTICE INSTABILITY OF V_3Si. Williamson, S.J.; Ting, C.S.; Fung, H.K. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. Lett. 32: No. 1, 9-12 (7 Jan 1974).

The magnetic field dependence of the structural transformation temperature of a single crystal of V_3Si has been measured up to 156 kOe. Quantitative agreement with the Weger–Labbé–Friedel model is obtained with appropriate band parameters and a density of states that accounts for finite lifetimes of the d electrons. (auth)

8316 THEORY OF MAGNETICALLY COUPLED TYPE-II SUPERCONDUCTING FILMS. Clem, John R. (Ames Laboratory-USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. B 9: 898-911 (1 Feb. 1974).

The current–voltage characteristics of a magnetically coupled pair of infinite type-II superconducting films of finite thickness, separated by an insulating layer, are calculated. The main features of the time-averaged primary and secondary flux-flow voltages $\bar{V}_p$ and $\bar{V}_s$ versus the primary and secondary currents I_p and I_s are found to depend upon only five parameters: the primary and secondary critical depinning currents I_{pc} and I_{sc}, the primary and secondary flux-flow resistances R_p and R_s, and a coupling current I_ϕ, which is proportional to the maximum coupling force exerted on a secondary fluxoid by the displaced primary-fluxoid lattice. Model calculations of the current–voltage characteristics are performed to illustrate predicted behavior under varying strengths of current, pinning, and coupling. (auth)

8317 MAGNETIC COUPLING IN SUPERPOSED TYPE-II SUPERCONDUCTING FILMS. Ekin, J.W.; Serin, B. (Physics Department, Rutgers University, New Brunswick, New Jersey 08903); Clem, J.R. Phys. Rev. B 9: No. 3, 912-917 (1 Feb 1974).

A study has been made of the magnetic-coupling properties of vortex arrays in a dc superconducting transformer composed of two oxygen-doped aluminum films separated by a thin insulating layer. By doping to the appropriate level, very small depinning currents have been achieved, making possible an investigation of the vortex-coupling characteristics in a low-current regime free of heating instabilities. Measurements of the system's V–I characteristics have been obtained at currents more than an order of magnitude greater than the current at which the two vortex lattices cease to move at the same velocity. A simple periodic-coupling-force model has been used to generate theoretical V–I curves which are found to compare well with the experimental data. Values of the magnetic interaction force coupling the two vortex arrays have been determined as a function of temperature and intervortex spacing, and are compared with theory. (auth)

8318 CALORIMETRIC INVESTIGATION OF THE CONTINUOUS DEMAGNETIZATION OF Ce IMPURITIES IN SUPERCONDUCTING La, Th ALLOYS. Luengo, C.A.; Huber, J.G.; Maple, M.B. (Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92037); Roth, M. Phys. Rev. Lett. 32: No. 2, 54-58 (14 Jan 1974).

A calorimetric investigation of the magnetic–nonmagnetic transition of an impurity (Ce) in a superconducting binary-alloy matrix (La, Th) is reported for the first time. The continuous demagnetization of the Ce ions with increasing Th composition is documented in terms of the specific heat jump at the superconducting transition temperature T_c as a function of T_c. A recent calculation by Müller-Hartmann and Zittartz for superconducting Kondo systems describes these data remarkably well out to ~70 at.% Th, but fails at higher Th compositions. (auth)

8319 ELECTRON THERMAL CONDUCTIVITY OF SUPERCONDUCTORS. Geilikman, B.T.; Orlov, V.G. Sov. Phys.-Solid State 15: No. 7, 1400-1403 (Jan 1974).

Transport equations are obtained for superconductors with a nonzero temperature gradient. The standard phonon model and a linear approximation with respect to the temperature gradient are used in the derivation of these equations. The electron–electron scattering and the scattering of electrons by impurities are considered. An equation for the electron thermal conductivity due to the electron–electron scattering κ_{ee} is obtained. At low temperature, it assumes the form $\chi_{ee} \propto [(\text{const})/(\zeta\sqrt{\Delta T})][1+O(T/\Delta)]$. (auth)

8320 RELAXATIONAL OSCILLATIONS OF THE TRANSPORT CURRENT IN THIN SUPERCONDUCTING FILMS. Eru, I.I.; Peskovatskii, S.A.; Poladich, A.V. (Institute of Radiophysics and Electronics, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Solid State 15: No. 7, 1488-1489 (Jan 1974).

The excitation of relaxational oscillations of the transport current in thin superconducting tin films has been observed. Such oscillations appear to explain the existence of a nonthermal discontinuity in the current–voltage characteristic of superconducting thin films. (AIP)

8321 SOME SUPERCONDUCTING PROPERTIES OF MULTIFILAMENTARY NIOBIUM CARBONITRIDE. Ohmer, M.C.; Frederick, W.G.D. (Air Force Materials Laboratory, Solid State Materials Branch, Wright–Patterson Air Force Base, Ohio 45433). J. Appl. Phys. 45: No. 3, 1382-1384 (Mar 1974).

Superconducting properties of multifilamentary 10-μ niobium carbonitride fibers have been investigated. Niobium carbonitride has T_c's to 18 K and H_{c2}'s to 120 kOe. Critical current densities and their temperature dependence and the magnetic field dependence of the hysteretic loss have been determined from magnetization measurements. The fibers had J_c's in the range of 10^4 A/cm^2 for fields less than 50 kOe at 4.2 K. No flux jumping was observed, indicating that the fibers were intrinsically stable without a stabilizing matrix. The field dependence of the hysteretic loss was $\propto H^{2.4}$ for partial penetration. (auth)

8322 SUPERCONDUCTING COMPOSITE OF COPPER AND NIOBIUM–A METALLURGICAL APPROACH. Tsuei, C.C. (W. M. Keck Laboratory of Engineering Materials, California Institute of Technology, Pasadena, California 91109). J. Appl. Phys. 45: No. 3, 1385-1388 (Mar 1974).

Superconducting composites of niobium filaments in copper have been prepared by casting and subsequent cold working. In the cast copper-rich Nb alloys, there is a somewhag uniform distribution of Nb (~ 10μm average diameter) resulting from liquid-state precipitation. After cold rolling or or drawing, these Nb primary dendrites are elongated and aligned, and they eventually form quasicontinuous superconducting paths. Alloys containing more that 5 at.% Nb and with a cross-sectional area reduction ratio of ~ 400 to : 1 show a sharp resistive superconducting transition around 9°K. As an example, an alloy of composition $Cu_{90}Nb_{10}$ gives a critical current density J_c at 4.2°K and zero magnetic field of the order of 2×10^4 A/cm^2 and a critical field of ~ 10 kG. It is found that the addition of a small amount (a few at.%) of Al to the basic Cu-Nb alloys greatly improves the continuity of the Nb filaments. This in turn results in more uniform superconducting properties in various sections of a long wire. No degradation of the superconducting properties were observed after a 0.25-mm wire sample was bent and straightened more than 50 times around a 1-in. mandrel. In fact, the critical current density increases with the amount of bending. For example, J_c at 4.2°K and zero magnetic field of a 0.25-mm wire of $Cu_{90}Nb_{10}$ increases from 1.5×10^4 to 10^5 A/cm^2 after 20 bends.

8323 TRANSITION TEMPERATURES AND CRYSTAL STRUCTURES OF SINGLE-CRYSTAL AND POLYCRYSTALLINE NbN_x FILMS. Oya, G.; Onodera, Y. (Research Institute of Electrical Communication, Tohoku University, Sendai, Japan). J. Appl. Phys. 45: No. 3, 1389-1397 (Mar 1974).

Single-crystal cubic NbN_x films with thicknesses of a few thousand angstroms were epitaxially grown on cleaved (100) planes of single-crystal MgO plates by the vapor phase growth technique. By heat treatment of some of these films in NH_3+H_2 or in H_2 alone, films having the superlattice structures of Nb_4N_3, NbN, or Nb_4N_5 were prepared. The maximum T_c was observed in cubic NbN_x. Both Nb_4N_3 and Nb_4N_5, the tetragonal phases with long-range-ordered arrangement of vacancies, exhibited superconductivity. $NbN_{1.0}$ and Nb_5N_6, both with hexagonal structure, did not exhibit superconductivity down to 1.77 K. As the composition of cubic NbN_x became close to stoichiometric, its T_c increased. However, the maximum T_c of cubic NbN_x with nearly stoichiometric composition was limited by the lattice instability of cubic NbN_x and by the resulting cubic NbN_x to hexagonal NbN transformation. It might be expected that a higher T_c for compounds of the NbN family could be obtained if a NaCl-type crystal with less vacancies could exist as a stable or metastable phase at ordinary temperatures. (auth)

8324 SUPERCONDUCTIVITY IN Al FILMS DEPOSITED ON QUARTZ AND POLY(n–VINYLCARBAZOLE) AT 4.2°K. Russell, T.J.; Jones, M.E.; Johnson, A.C.; Deck, R.J.; Hermann, A.M. (Department of Physics, Tulane University, New Orleans, Louisiana 70118). J. Appl. Phys. 45: No. 3, 1470-1471 (Mar 1974).

Aluminum films have been evaporated from Al_2O_3 boats onto cold substrates (4.2°K) of z-cut crystalline quartz and an amorphous polymer, poly(n-vinylcarbazole) (PVK), and the critical temperatures have been measured resistively. Critical temperatures are enhanced above the bulk critical temperature. The maximum T_c's are 5.3°K on quartz and 4.7°K on PVK. The rather large enhancement is attributed to the use of the Al_2O_3 boats.

8325 AMPLITUDES AND LEVEL SPACINGS OF BOUND STATES IN SUPERCONDUCTING Cd. Colucci, S.L.; Tomasch, W.J.; Lee, H.J. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. Lett. 32: No. 11, 590-593 (18 Mar 1974).

Bound- and virtual-state structure has been observed in the tunneling characteristics of thick Cd films deposited over Pb. We observed amplitude effects displaying a temperature dependence not previously reported. An important point is made concerning basic spacings of bound and virtual levels. Amplitudes and level spacings appear to contain retrievable proximity-effect information. Taking nonlinear effects into account, a value of $v_F = 1.30 \times 10^8$ cm/sec is obtained for the c direction. (auth)

8326 NONLINEAR PROPERTIES OF GRANULAR SUPERCONDUCTING FILMS. Likharev, K.K. (M. V. Lomonosov Moscow State University). Sov. Phys.–Solid State 15: No. 8, 1679-1680 (Feb 1974).

A model for a thin granular superconducting film has been developed to show that the nature of the static current–voltage characteristic and its rapid response to microwaves can be explained satisfactorily by the Josephson effect at contacts between separate grains in the film. (AIP)

8327 EFFECTS OF SUPERCONDUCTING FLUCTUATIONS ON THE ULTRASONIC ATTENUATION IN A THIN ALUMINUM FILM. Robinson, D.A.; Maki, K.; Levy, M. (Department of Physics, University of Wisconsin–Milwaukee, Milwaukee, Wisconsin 53201). Phys. Rev. Lett. 32: No. 13, 709-712 (1 Apr 1974).

The attenuation of 2–GHz acoustic surface waves in a 300–Å aluminum film has been measured in the temperature region around the superconducting transition temperature. The simple BCS theory yields a gap parameter of 3.60. While microwave electromagnetic–attenuation measurements in the film indicate critical fluctuation effects near T_c, there appear to be no such fluctuation effects in the ultrasonic–attenuation data of this short–mean–free–path Al film. (auth)

8328 POSITIVE CURVATURE OF THE H_{c2}–VERSUS–T_c BOUNDARIES IN LAYERED SUPERCONDUCTORS. Woollam, J.A. (National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio 44135); Somoano, R.B.; O'Connor, P. Phys. Rev. Lett. 32: No. 13, 712-714 (1 Apr 1974).

We have found what we believe to be a universal characteristic of layered superconductors: A positive curvature of H_{c2}–versus–T_c boundary. The origins of the effect are believed to be associated with strong anisotropies of the Fermi surface and electron-phonon interaction. (auth)

8329 CONDUCTIVITY OF ONE–DIMENSIONAL INTERACTING FERMIONS. Mattis, D.C. (Belfer Graduate School of Science, Yeshiva University, New York, New York 10033). Phys. Rev. Lett. 32: No. 13, 714-717 (1 Apr 1974).

Using an exactly soluble model, the decay rate of a current–carrying state of one–dimensional fermions is calculated in the presence of random scatterers at finite temperature and the dc conductivity thereby inferred. For interacting fermions it is modified by a factor $(T/T + \theta)^g$, where g is a positive (negative) coupling constant for repulsive (attractive) two–body forces. While the conductivity could be greatly enhanced for $g < 0$ and $T \ll \theta$, one–dimensional superconductivity appears ruled out at any finite temperature. (auth)

8330 THRESHOLD EFFECTS AND LARGE T_c REDUCTIONS IN NEUTRON–IRRADIATED A–15 SUPERCONDUCTORS. Schweitzer, D.G.; Parkin, D.M. (Brookhaven National Laboratory, Upton, New York 11973). Appl. Phys. Lett. 24: No. 7, 333-335 (1 Apr 1974).

A–15 superconductors show very large decreases in critical temperature after 60 °C neutron irradiations exceeding about 10^{18} neutrons/cm^2 (E > 1 MeV). These effects are not observed in superconductors such as Nb, NbN, or Nb–Ti. (auth)

8331 RESIDUAL SURFACE RESISTANCE OF SUPERCONDUCTORS AT MICROWAVE FREQUENCIES. Kartheuser, E.P.; Rodriguez, S. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). Appl. Phys. Lett. 24: No. 7, 338-340 (1 Apr 1974).

A microscopic theory of the residual surface resistance is presented and compared with experimental results in superconducting lead and niobium. It is shown that for frequencies above 1 GHz, direct electromagnetic generation of acoustic shear waves can account for the measured residual surface resistance. (auth)

8332 JOSEPHSON JUNCTIONS AT 45 TIMES THE ENERGY–GAP FREQUENCY. McDonald, D.G.; Petersen, F.R.; Cupp, J.D.; Danielson, B.L.; Johnson, E.G. (Cryogenics and Quantum Electronics Divisions, National Bureau of Standards, Boulder, Colorado 80302). Appl. Phys. Lett. 24: No. 7, 335-337 (1 Apr 1974).

Superconductive Nb–Nb point contacts have been studied with

9.5-μm radiation from CO_2 lasers. Two models are considered to explain the experiments: one is Werthamer's Josephson junction model and the other is a thermally modulated Josephson junction. The evidence favors Werthamer's model but is not conclusive. (auth)

8333 APPLICATION OF GRATINGS IN FABRICATING ARRAYS OF SUPERCONDUCTING AND NORMAL JUNCTIONS. Tsang, W.; Wang, S. (Department of Electrical Engineering and Computer Sciences and the Electronics Research Laboratory, University of California, Berkeley, California 94720). Appl. Phys. Lett. 24: No. 10, 519-522 (15 May 1974).

Here we propose and demonstrate new applications of diffraction gratings, made on photoresists by optical interference of two laser beams, in fabricating one- and two-dimensional arrays of superconducting and normal junctions. By depositing metal films on photoresist gratings, it is possible to fabricate uniformly and closely spaced junctions. Junction arrays with submicron dimensions can be much more easily made with this technique than with the presently available techniques. Furthermore, the proposed technique offers the potential capability of producing more than 10^8 junctions per mm^2 over an area of several cm^2. (auth)

8334 VORTEX-LINE PINNING BY THICKNESS MODULATION OF SUPERCONDUCTING FILMS. Daldini, O.; Martinoli, P.; Olsen, J.L. (Laboratorium für Festkörperphysik, Eidgenössische Technische Hochschule Zürich, Zürich, Switzerland); Berner, G. Phys. Rev. Lett. 32: No. 5, 218-221 (4 Feb 1974).

We present experimental evidence for the interaction of vortex lines with a controlled pinning configuration induced by periodic thickness modulation of superconducting films. The critical current density as a function of a transverse magnetic field shows characteristic peaks at well-defined field values. These features give evidence for matching of the two-dimensional vortex-line lattice with the one-dimensional periodic pinning structure. A model is proposed which accounts for the observed temperature dependence of the matching effects. (auth)

8335 TWO-PHONON DEFORMATION POTENTIAL AND SUPERCONDUCTIVITY IN DEGENERATE SEMICONDUCTORS. Ngai, K.L. (Naval Research Laboratory, Washington, D. C. 20375). Phys. Rev. Lett. 32: No. 5, 215-218 (4 Feb 1974).

It is shown that attractive electron-electron interaction arising from the exchange of two optical phonons is a possible mechanism for superconductivity in some degenerate semiconductors. This mechanism is present independent of whether the semiconductor is many-valley or not. Application to $SrTiO_3$ is discussed. (auth)

8336 OBSERVATION OF A PHASE-DEPENDENT CONDUCTIVITY IN SUPERCONDUCTING POINT CONTACTS. Vincent, D.A.; Deaver, B.S. Jr. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. Lett. 32: No. 5, 212-215 (4 Feb 1974).

Measurements of the impedance of phase-biased superconducting point contacts are interpreted in terms of the Josephson expression for the total current, $i = i_c \sin\phi + G_0(1 + \alpha \times \cos\phi)V$. The data give good agreement with this expression and yield a parametric inductance $L(\phi) = \hbar/2ei_c \cos\phi$ and a phase-dependent conductance $G(\phi) = G_0(1 + \alpha \cos\phi)$, with $\alpha \simeq -1$. (auth)

8337 ELECTRON-PHONON COUPLING IN TRANSITION METALS AND RESONANT SCATTERING. Chui, S. (Joseph Henry Laboratories of Physics, Princeton University, Princeton, New Jersey 08540). Ann. Phys. (N.Y.) 80: No. 2, 361-386 (Oct 1973).

An explicit formula is derived for the electron-phonon coupling of transition metals in terms of parameters that are used in first principle transition metal band structure calculations. Its relevance and systematics are discussed. (auth)

8338 DIRECT CURRENT INDUCTANCE BRIDGE FOR CURRENT-QUANTUM-PHASE MEASUREMENTS IN SUPERCONDUCTORS. Meservey, R.; Paraskevopoulos, D.; Gruenberg, L.W.; Tedrow, P.M. (Francis Bitter National Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Appl. Phys. Lett. 24: No. 11, 570-573 (1 June 1974).

A zero-frequency inductance bridge has been constructed for measurement of the inductance of superconducting circuit elements. The null detector uses a quantum magnetometer. The bridge is balanced by resistance adjustments at room temperature and gives directly the inductance or the quantum phase difference versus the current across the unknown superconducting element. The bridge has been used to measure kinetic inductors with 4×10^{-7} H to one part in 10^4 with a measuring current of 5×10^{-6} A. (auth)

8339 SUPERCONDUCTIVITY IN AlN BISTABLE RESISTANCE DEVICES. Harris, E.P. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Appl. Phys. Lett. 24: No. 10, 514-516 (15 May 1974).

The observation of superconductivity is reported in the low-resistance states of AlN bistable resistance devices. The data are interpreted as evidence in favor of the existence of a metallic microbridge between the device electrodes. (auth)

Equipment and Devices

Refer also to abstracts 6325, 7528, 8325, and 8333.

8340 (LNF-73-66) DESIGN OF A DIRECT CURRENT SUPERCONDUCTOR DIPOLE. Pasotti, G.; Spadoni, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 6 Dec 1973. 28p. (In Italian). Dep. NTIS (US Sales Only) $4.50.

The design specifications of the primary components of a superconductor dipole were calculated. The principal parameters of the magnet are tabulated. (JSR)

8341 ELECTRIC MAGNET WITH SUPERCONDUCTIVE WINDINGS. Eisel, W. (to Siemens Aktiengesellschaft). US Patent 3,801,942. 2 Apr 1974. Priority date 27 Mar 1972, F.R. Germany. 8p.

A superconductive magnet coil having an elongated cylindrical dipole superconducting winding is supported on a carrier cylinder, the winding comprising two winding components shaped as cylinder segments which are symmetrical with respect to a plane of symmetry which goes through the longitudinal axis of the carrier cylinder and which is perpendicular to the magnetic field of the coil. The winding components each consist of a plurality of superimposed winding layers each having axially extending sides approximately parallel to the longitudinal axis of the carrier cylinder and circumferentially extending winding heads, the mutually corresponding winding layers of these winding components cooperatively forming cylindrical layers. On at least one side each of the winding layers has bare uninsulated surfaces contacting a liquid permeable layer through which a coolant can pass in axial, tangential and radial directions in such a manner that each winding layer can be wetted by the coolant on at least that side. Support bars extend between the respective axially extending sides of the two winding components to support them circumferentially apart, and these bars have relatively large coolant passages formed in them and extending radially with respect to the coil winding from the liquid permeable layers to the outer periphery of the coil. The winding components are held together on the winding carrier cylinder by high-tensile strength wrappings and suitably shaped cores are positioned within the components' windings, and smaller coolant passages are formed through these parts so as to extend radially from the liquid permeable layers to the outer coil periphery. The magnet coil may be operated horizontally as well as vertically, immersed in a liquid coolant bath. (auth)

8342 METHOD OF FABRICATING A HOLLOW COMPOSITE SUPERCONDUCTING STRUCTURE. Shattes, W. J.; Maranoik, W. G.; Kirk, B. S. (to Air Reduction Co., Inc.). US Patent 3,800,414. 2 Apr 1974. Filed date 12 Oct 1972. 8p.

A core element comprising superconducting strands in a normally conducting matrix is initially extruded in a desired cross-sectional shape or configuration, and is then interposed in a prefabricated or postfabricated tube, and coreduced to a final product of desired dimensions, thus providing a matrix having a plurality of longitudinal internal channels. The core elements may assume a variety of cross-sectional shapes, such as ribbon, square, cross, triangle, star, annulus, etc., or a composite of these. In an alternative process, a cable is formed by twisting or braiding together a plurality of superconducting matrix wires, prior to coreduction in a prefabricated or postfabricated tube. In another form, a superconducting matrix strip is welded to form a tube. In a variation of this, superconductor wires are interposed in longitudinal slots in a billet of normally conducting material which is rolled into a ribbon, alternatively formed into a tube. The product of any of these techniques is finally coreduced to a wire which is formed into a coil which may be cooled internally by a forced cooling system including fluid or superfluid helium. (auth)

8343 EXPERIMENTAL STABILIZED SUPERCONDUCTING MAGNET WITH AN INSIDE DIAMETER OF 700 mm. Vetlitskii, I. A.; Belonogov, A. V.; Dobrov, V. M.; Krylov, V. L.; Lebedev, A. V.; Lomkatsi, G. S.; Nilov, A. F.; Smolyankin, V. T. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1555-1558(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 217-221(1973).

A stabilized superconducting magnet with an inside diameter of the winding equal to 730 mm and an outside diameter of 1000 mm,

a maximum magnetic field induction of 2.4 T, a working current of 820 A, a design current density of 2560 A/cm², a stored energy of 500 kJ, a superconductor (Nb + 50% Zr alloy) weight of 23 kg is described. A description is given of the construction of the magnet, and results are presented of tests performed on the magnet in order to study the conditions governing stabilization and the development of induced currents in the winding. (auth)

8344 FLUCTUATION POWER SPECTRUM OF A JOSEPHSON JUNCTION. Biswas, A. C.; Rama Rao, I. (Tata Inst. of Fundamental Research, Bombay). Pramana; 2: No. 2, 51-53 (Feb 1974).

The fluctuation power spectrum of the Josephson junction has been evaluated in the limit of large energy barriers [$(U_n^{max} - U_n^{min})\gamma$] $\gg 1$ and small currents [$x \ll x_c$]. The result is valid for finite capacitance of the junction. The effect of the fluctuating Josephson current on the voltage V(t) across the junction has also been taken into account. (auth)

8345 PROPAGATION OF THE RESISTIVE REGION IN HIGH CURRENT DENSITY SUPERCONDUCTING COILS. Hagedorn, D.; Dullenkopf, P. (Univ., Bochum, Ger.). Cryogenics; 14: No. 5, 264-270(May 1974).

A method is given describing the propagation phenomenon of the resistive region within the winding of superconducting coils wound from semistabilized filamentary conductors. The method permits the approximate calculation of the velocities of propagation of the normal conducting front in superconducting coils of high current density. The calculation is carried out assuming that the parameters of the conductor materials, the short sample data, and the heat transfer coefficient from the conductor into the ambient medium are given. The propagation velocities of the normal front have been measured in insulated wires freely immersed in liquid helium, in test samples using conventional interleaving material, and in compact multilayer coil wound from the same wire. The calculated results are compared with experimental data. (auth)

8346 MAGNETIC SUSCEPTIBILITY MEASUREMENTS USING A SUPERCONDUCTING MAGNETOMETER. Cukauskas, E.J.; Vincent, D.A.; Deaver, B.S. Jr. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). Rev. Sci. Instrum. 45: No. 1, 1-6 (Jan 1974).

The design and performance of an apparatus for measuring magnetic susceptibility using a superconducting magnetometer and superconducting magnet and shields are described. Measurements of static susceptibility and of nuclear magnetic resonance have been made with this system. Volume susceptibility changes of 10^{-10} cgs can be measured with a 1 sec response time, a 100 Oe applied field, and a 1 cm³ sample. Noise limitations and potential for improvement of sensitivity by several orders of magnitude are discussed. (auth)

8347 FABRICATION OF EXPERIMENTAL JOSEPHSON TUNNELING CIRCUITS. Greiner, J.H.; Basavaiah, S.; Ames, I. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Vac. Sci. Technol. 11: No. 1, 81-84 (Jan 1974).

A multilevel thin-film process has been developed for fabricating experimental circuits containing Josephson tunneling gates, insulated crossings, superconducting contacts, and terminating resistors. The process utilizes a Nb film for the ground plane and Pb alloy films for overlying superconducting layers. Insulation is achieved through the use of vacuum-deposited SiO films and anodization of the Nb ground plane. An oxide formed by rf sputter-etching in an oxygen plasma is used for forming the tunneling barriers. Photoprocessing techniques are used for patterning. Through use of the process it has been possible to fabricate experimental memory and logic circuits which survive thermal cycling to 4.2 K and intervening storage at room temperature without significant changes in electrical characteristics. (auth)

8348 PARTICLE DETECTION WITH SUPERHEATED SUPERCONDUCTING GRAINS. Biot, J.; Pellan, Y.; Pineau, J.C.; Rosenblatt, J. (Institut National des Sciences Appliquées 35031 Rennes, Cedex, France). J. Appl. Phys. 45: No. 3, 1429-1435 (Mar 1974).

Electrons having kinetic energy of the order of a few hundred keV can induce superconducting-to-normal transitions in an assembly of metallic spheres in a superheated state. We study this phenomenon in several type I superconductors (In, Hg, Sn, and Sn-Pb alloy) at different electron energies. Experiments show that the transition cross section is strongly dependent upon grain size and thermal properties of the superconductor. We develop a phenomenological model which qualitatively describes the above features, as well as the field and temperature dependence of the transition probability. Possible application to particle detection, particularly of low-energy charged particles and heavy ions, are discussed. (auth)

8349 EFFECT OF HIGH-TEMPERATURE HEAT TREATMENT ON PENETRATION DEPTH OF SUPERCONDUCTING NIOBIUM. Varmazis, C.; Joshi, A.; Luhman, T.; Strongin, M. (Brookhaven National Laboratory, Upton, New York 11973). Appl. Phys. Lett. 24: No. 8, 394-395 (15 Apr 1974).

A discussion is given of the change in penetration depth λ at the surface of niobium with various heat treatments and of the causes of the large changes in λ. In particular, the distribution of oxygen in from the sample surface is discussed, along with the thermal faceting caused by heating niobium to high temperatures at pressures near 10^{-6} Torr. (auth)

8350 CONVERSION OF ELECTROMAGNETIC INTO ACOUSTIC ENERGY USING Sn, Au, AND Cu FILMS AT LOW TEMPERATURES. Zemel, A.; Goldstein, Y. (The Racah Institute of Physics, The Hebrew University of Jerusalem, Jerusalem 91000, Israel). Phys. Rev. B 9: No. 4, 1499-1505 (15 Feb 1974).

Transverse acoustic waves were generated electromagnetically at 9 GHz using thin films of tin, gold, and copper on silicon substrates. We report measurements of the conversion efficiency α of electromagnetic into acoustic energy as a function of temperature and film thickness at and below 4.2 K and preliminary results at liquid-N_2 temperature. The highest conversion efficiencies found at 4.2 K for Sn and Au were 1×10^{-5} and 2.5×10^{-5}, respectively. In the temperature range of 1.4-4.2 K, the values of α for normal metals were found to be practically temperature as well as microwave-power independent. The value of α for superconducting tin decreases strongly below the superconducting transition temperature and becomes magnetic field and microwave-power dependent. This is in agreement with our previous results on indium. Using gold films we measured the thickness dependence of α in the range of $\pi < qd < 4\pi$, where q is the acoustic wave number in the metal in d is the film thickness. We find a pronounced maximum at $qd = 2\pi$ and indications for another maximum at $qd = 4\pi$. The values of α at 4.2 K as well as the temperature and thickness dependence of α are found to be in good agreement with the theory based on diffuse surface scattering of the conduction electrons. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 6690, 6810, 7387, 8471, and 8489.

8351 (HEDL-SA-685) SHIELDING FACTOR INTERPOLATION SCHEMES. Kidman, R. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-2170. 6p. (CONF-740608-9). Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

The appropriateness of the f-factor interpolation schemes used in the 1 DX cross section preparation code is examined. The effect of the interpolation schemes on fast reactor parameters is discussed. (JWR)

8352 (RT/FI-(74)3) NUCLEAR DATA AND INTEGRAL MEASUREMENTS CORRELATION FOR FAST REACTORS. Part 3. The Consistent Method. Gandini, A.; Salvatores, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan 1974. 38p. Dep. NTIS (US Sales Only) $5.00.

A new correlation method between differential data and integral measurements performed on fast reactors is formulated. Such a method is based on correcting directly the nuclear parameters in a way consistent with the theoretical models adopted for use by the group cross-section generation. The main resulting advantage consists in the independence of the adjustment from any energy group schematization. (auth)

8353 USE OF GAMMA RAYS FROM INELASTIC SCATTERING FOR THE MEASUREMENT OF NEUTRON SLOWING-DOWN TIMES IN THE SUB-MICROSECOND REGION. Beyon, T. D.; Walker, J. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 117: No. 1, 177-182(1974).

Studies were made which demonstrated that inelastic neutron scattering, $(n,n'\gamma)$, in a suitable isotope can provide the basis for an indicator for fast-neutron slowing-down-time measurements in the sub-microsecond region. Observation of the time-dependent reaction rates of the emitted gamma rays from the excited states in the indicator allowed the slowing-down times to be defined. The competing effects of different levels and the effects of level lifetimes were considered. Numerical examples are provided for neutron slowing-down to 110 keV in natural iron with ^{19}F used as an indicator. (2 figures, 2 tables) (auth)

8354 SPECTRAL-ANGULAR DISTRIBUTION OF FAST NEUTRONS EMERGING FROM DIFFERENT SECTIONS OF THE SURFACE OF AN IRON REFLECTOR. Pozdneev, D. B.; Faddeev, M. A. Sov. J. At. Energy (Engl. Transl.); 34: No. 3, 145 (Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 114(Feb 1973). This is a summary of paper No. 650/7000 with full copy held by TIC.

The Monte Carlo method was used for calculating the differential energy spectra of neutrons emerging from different sections of the surface of an iron reflector. The analysis was performed for different reflector sections relative to a centrally located source for six ranges of polar angle and in two azimuthal directions. Contributions of the single and multiply scattered neutrons to the total albedo were taken into account. Differential energy spectra of reflected fast neutrons emerging from different sections of the surface of an iron reflector with a thickness of 40 cm in the range 0 to 15° are shown. The results obtained were explained by taking into account the elastic and inelastic scattering of fast neutrons and the excitation of individual nuclear levels. (RWR)

8355 NEUTRON PULSES SLOWING DOWN IN HEAVY MEDIA: ANALYSIS WITH APPLICATIONS OF THE LEAD SPECTROMETER. Sawan, M.; Conn, R. W. (Univ. of Wisconsin, Madison). Nucl. Sci. Eng.; 54: No. 2, 127-142(Jun 1974).

Methods for the analysis of neutron pulses slowing down in heavy media are presented. The Green's function coupling method is reviewed, and the application of a prompt-jump approximation to pulses slowing down in heavy media is discussed. These methods are applied in particular to the analysis of the lead slowing-down-time spectrometer (LSDTS) and the application of this device to nondestructive fissile material assay (NDA). The effects of pulse width, spectrometer size, higher-order spatial modes, and lead cross-section data on the calibration curve (t versus $1/\sqrt{E}$), the dieaway curve N(t) versus t, and the time-dependent spectrum of the LSDTS are reported. For NDA, the assay of fresh light-water reactor (LWR), plutonium recycle, and fast-reactor fuel pins, as well as spent LWR fuel pins, is studied. The effects of self-shielding and pulse width on the discrimination capability of the LSDTS are assessed. Two energy ranges (27.6 to 43.6 eV and 10.3 to 16.3 eV) are proposed for the assay of mixed-oxide fuel where discrimination between ^{235}U and ^{239}Pu is required. An error analysis of NDA with lead spectrometers that includes the calibration surfaces which occur in the assay of mixed-oxide fuel pins is given. (18 figures, 2 tables) (auth)

8356 ORNL BENCHMARK EXPERIMENT FOR NEUTRON TRANSPORT IN THICK SODIUM. Maerker, R. E.; Muckenthaler, F. J.; Childs, R. L. (Oak Ridge National Lab., TN). Nucl. Technol.; 22: No. 2, 275-297(May 1974).

An experiment concerning deep neutron penetration in sodium was performed, and experimental results were obtained which provide a basis for verification of the accuracy of sodium cross sections to be used in transport calculations. The experiment was conducted at the Tower Shielding Facility of Oak Ridge National Laboratory, and included measurements of both the neutron fluence and the neutron spectra through a large diameter sample of sodium up to 15 ft thick. Calculated results for the experiment were also compared with the experimental measurements. These results were obtained by using the multigroup Monte Carlo code MORSE and a two-dimensional discrete ordinates code, DOT-III. One-hundred-group data sets were developed from both a preliminary and the final version of the ENDF/III set (MAT-1156) for sodium for use in the calculations. Comparisons of the calculations with experiment indicate that the preliminary version is slightly superior to the final version and, in using the preliminary set, the total neutron leakage above thermal energies penetrating through 15 ft of sodium agrees to within ~15%, and the absolute spectra penetrating through 12.5 ft of sodium, when integrated over the energy range of the measurement, agrees to within 20%. For the final set, the corresponding comparisons are 30% and 60%. (15 figures, 21 tables) (auth)

8357 SOLUTIONS OF THE STEADY, ONE-SPEED NEUTRON TRANSPORT EQUATION FOR SMALL MEAN FREE PATHS. Larsen, E.W. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). J. Math. Phys. (N.Y.) 15: No. 3, 299-305 (Mar 1974).

The solution of the steady, one-speed neutron transport equation with isotropic scattering and small mean free path is obtained. The solution is asymptotic with respect to a small parameter ϵ, defined as the mean free path in terms of a unit length of the same order of magnitude as a typical dimension of the domain. The solution, the leading two terms of which are given, consists of a boundary layer solution plus an interior solution. The boundary layer solution decays exponentially with distance from the boundary, the decay rate being proportional to ϵ^{-1}, and it shows the effects of boundary curvature and variations in the incoming flux along the boundary. The interior solution is a multiple of the source for subcritical domains, and depends on a diffusion equation for near critical domains. The boundary condition for the diffusion equation and an asymptotic criticality condition are derived. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 8054, 8085–8089, 8227, 8281, 8397, 8398, 8402, and 8453.

8358 INVESTIGATION OF THE ENERGY SPECTRUM IN REACTION $^4He(e,e'p)^3H$. Gol'dshentein, V. A.; Shostak, V. B.; Afanas'ev, N. G.; Vlasenko, V. G.; Kuplennikov, E. L.; Startsev, V. I. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 19: No. 4, 727-728(Apr 1974). (In Russian).

Cross section of the reaction $^4He(e,e'p)^3H$ is measured as function of the proton separation energy using the electron beam of ELA-2000 with the energy of 1187 MeV. The proton binding energy is obtained to be 17 ± 1 MeV; the suppression coefficient is 0.87. (auth)

8359 POSITIVE ENERGY BOUND STATES IN RESONATING GROUP CALCULATIONS. Clement, D.; Schmid, E. W.; Teufel, A. G. (Institut fuer Theoretische Physik, Tubingen, Ger.). Phys. Lett.; 49B: No. 4, 308-310(29 Apr 1974).

Spurious resonances occurring in numerical resonating group calculations off the oscillator limit are explained as being due to positive energy bound states. A generalization of Swan's version of the Levinson theorem is given which takes into account these states. (auth)

8360 SINGULARITY SUBTRACTION METHOD FOR EXTRACTING SPECTROSCOPIC INFORMATION FROM NUCLEAR REACTION DATA. Borbely, I. (Laboratory of Theoretical Physics, Dubna, USSR). Phys. Lett.; 49B: No. 4, 325-328(29 Apr 1974).

An exact method for determining the strength of the nearest singularity of the differential cross section is proposed, thus information is obtained on the structure of nuclei in a completely model-independent way. Using this method the $t \rightarrow d + n$ vertex constant was determined with an impressively small error. The connection with similar methods is discussed. (auth)

8361 BOUND (NΔ(1236))-STATE AND ITS DECAY. Arenhoevel, H. (Univ., Mainz). Phys. Lett.; 49B: No. 4, 329-331 (29 Apr 1974).

The possible existence of a bound state of the (NΔ(1236))-system was investigated. Using a regularized OPE-potential of pure exchange type one finds that the ($T = 2$, $J^P = 2^+$)-state is bound, where the binding energy is rather strongly dependent on the regularization parameter. The decay width of the bound Δ is strongly reduced by the binding effect and the Pauli principle, e.g., for a binding energy of 18 MeV the width is only 16 MeV. (auth)

8362 THREE-BODY PROBLEM. Amado, R. D. (Univ. of Pennsylvania, Philadelphia). pp 254-271 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The two aspects of the three-body problem in nuclear physics are considered, these being the bound state aspect and the scattering and break-up aspect. For the bound state problem, there are several properties of the triton to be calculated, including binding energy, charge radius and form factors. Different methods of estimating these quantities are reviewed. Some of the basic problems in three-body scattering are discussed, with final-state interactions and the behavior of the scattering amplitudes at threshold being among the most intractable so far. (CMS)

8363 EVIDENCE FOR A STRONG THREE-BODY FORCE IN THE TRITON. Brayshaw, D. D. (Stanford Linear Accelerator Center, CA). pp 140-144 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

In view of the fact that three-body calculations with apparently "realistic" two-nucleon potential models underbind ^{3}He by about 1.7 MeV and produce only rough agreement with its charge form factor, it appears necessary to make some changes in the theoretical assumptions. The possibility that these discrepancies are due not to off-shell effects, but to the existence of a strong three-body force is investigated. The existing charge form factor data for ^{3}He, ^{3}H are used to produce a model of the triton wave function compatible with these constraints. Given this wave function, the Schrödinger equation may be trivially solved for the effective local potential. The discrepancy between this potential and those predicted by typical pair-interaction models in the domain where all three particles are close together appears to provide clear evidence of a strong attractive three-body force. (auth)

8364 COULOMB EFFECTS IN THE NEAR-ON-SHELL NUCLEON–NUCLEON T-MATRIX. Tandy, P. C.; McCarthy, I. E. (Flinders Univ. of South Australia, Bedford Park). pp 90-92 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

One region of phase space where a simplified reaction theory is known to describe certain aspects of the nucleon-deuteron breakup problem reasonably well is the quasi-free region, where the momentum transfer in the reactions d(p,2p)n and d(n,2n)p is close to zero. For incident energies above 100 MeV the on-shell impulse approximation is known to give quite a good description of the shape of the momentum-transfer distribution, although the fact that the unitarity condition is not satisfied by this approximation means that the magnitude of the cross section is seriously overestimated. The off-shell impulse approximation (first-order term in the multiple-scattering series) is calculated for these reactions. The effects on the differential cross section are almost undetectable, differing from the value in the on-shell approximation by, at most 5%. For Coulomb effects, at small angles, however, the off-shell approximation is more valid. (auth)

8365 PERTURBATIVE CALCULATION OF SPIN OBSERVABLES IN ELASTIC NUCLEON–DEUTERON SCATTERING. Pieper, S. C. (Argonne National Lab., IL). pp 308-313 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The calculations of Aaron, Amado and Yam (1965) showed that the cross sections in N-d scattering could be quite well predicted using just simple S-wave two-nucleon forces. However, one does not get any N-d polarizations with these forces. Calculations by Sloan using the AAY model demonstrated the importance of treating the S-wave part of the N-N interaction in an exact manner since the Born series expansion of the Faddeev equations is, at best, very slowly convergent. However, one could hope that the remainder of the N-N interaction is weak enough to be handled in a perturbative manner using some sort of two-potential formalism. Such a scheme is described using the Alt, Grassberger and Sandhas (AGS) formulation of the Faddeev equations. It is shown that this perturbative technique is quite reliable and can profitably be used with even more complicated potentials. It is clear that one needs to have a fairly complete structure in the N-N interaction in order to be able to predict all of the N-d polarizations. (auth)

8366 N–d SCATTERING WITH LOCAL POTENTIALS BELOW BREAKUP THRESHOLD USING VARIOUS SEPARABLE EXPANSIONS. Fournier, A.; Kok, L. P. (Rijksuniversiteit, Groningen, Netherlands). p 329 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Three-boson model N-d scattering calculations were performed with the local Hulthén potential $V(r) = -s/(e^r - 1)$ below breakup threshold, for a value of the interaction strength parameter $s = 1.447$, which generates a two-body bound state with energy -0.05. The Mitra–Faddeev equations were reduced to a system of coupled one-dimensional Fredholm integral equations by use of separable expansions of the local interaction. The Weinberg expansion was used, and the unitary pole expansion (UPE). N-d phases for $l > 1$ are accurately given already by one separable term in both cases. (auth)

8367 DEUTERON BREAK UP WITH SEPARABLE POTENTIALS. Ebenhoeh, W. (Univ., Heidelberg). pp 325-328 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

For separable 2-body s-wave potentials the integral equations for the breakup amplitude can be solved numerically. The calculation is now a routine calculation which takes about 15 minutes on an IBM 360/75 computer (for one incident energy). The program is offered for common use. The program gives the amplitudes $T_\alpha(p)$ in a parameterized form. The program can also be used for comparison with p + d break-up experiments. For n + d break-up experiments in each case one has to carry out a Monte Carlo simulation of the experiment. The calculation predicts a double minimum in the differential singlet cross section ($n + d \rightarrow n + d^*$) which was found experimentally. (auth)

8368 FORWARD D(p,2p)n REACTION AT 51.8 MeV. Sanada, J. (Tokyo Univ. of Education); Seki, S.; Kimura, F.; Oryu, S. pp 339-342 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Many experimental and theoretical investigations were made for the D(p,2p)n reaction at low energies. Most of the works have concerned primarily to the kinematical region where quasi-free scattering predominates. Results are presented of the measurement on the forward D(p,2p)n reaction at 51.8 MeV and comparisons with existing theories, particularly with calculations based on the three-body Faddeev formalism. The measurement was made for coplanar symmetric geometry with $\Theta_1 = -\Theta_2 = 8.5$ and 12.5°. (auth)

8369 COMPARISON OF THE AMADO MODEL TO SIMPLE MODELS FOR THE REACTION D(p,2p)n AT 30.3 MeV. Margaziotis, D. J. (California State Univ., Los Angeles); Epstein, M. B.; Anzelon, G.; Slaus, I. pp 334-338 of Few Particle Prob-

lems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The reaction D(p,2p)n was studied at E_{inc} = 30.3 MeV. The validity of the Amado model in this energy region is established for breakup processes dominated by the two-body features of quasifree scattering (QFS) and final-state interactions (FSI); the application of the Amado model is compared with other currently used models such as the Watson–Migdal model and the modified simple impulse approximation (MSIA) using a sharp radial cutoff; and deviations from the Amado model are discussed. (auth)

8370 CHARGED-PARTICLE RADIATIVE CAPTURE AT LOW ENERGIES. Tombrello, T. A. (California Inst. of Tech., Pasadena). pp 327-344 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

Since the capture of charged particles at low velocities forms a basic part of many astrophysical processes, the determination of the appropriate reaction cross sections at the energy relevant to a particular stellar environment is of crucial importance to understanding not only energy generation in stars but also the details of the synthesis of the elements. However, the Coulomb repulsion of the interacting particles usually makes it impossible to measure the very low cross sections that are typical at the temperatures associated with stellar processes. Thus, the problem must be approached indirectly; the capture cross section is measured to as low an energy as is feasible; then one must rely upon theoretical models to extrapolate to the region of interest in astrophysics. The interplay of experiment and theory is thus essential for the solution of most problems, and provides the basic theme of this paper. Examples are taken from the major astrophysical processes (the proton–proton chain, the CNO cycle, and helium burning)—wherever the reactions involved embody important facets of experimental or theoretical technique. (11 figures) (auth)

8371 PHOTODISINTEGRATION OF DEUTERIUM DETERMINED FROM THE ELECTRODISINTEGRATION PROCESS. Skopik, D.M.; Shin, Y.M.; Phenneger, M.C.; Murphy, J.J. II (Saskatchewan Accelerator Laboratory, University of Saskatchewan, Saskatoon, Canada S7N OWO). Phys. Rev. C 9: No. 2, 531-536 (Feb 1974).

The equivalent photon cross sections were extracted from deuteron electrodisintegration measurements over an energy range of 17 to 28 MeV. Proton angular distributions were measured at 12 photon energies and the total cross section determined with an experimental uncertainty of approximately $\lesssim$ 6%. The differential cross section at 90 ° c.m. was also measured. Satisfactory agreement is found between deuteron photodisintegration theory and our measurements. A comparison with other recent (γ, p) cross section measurements is made. (auth)

8372 THEORY OF FINAL-STATE INTERACTIONS IN THREE-PARTICLE SYSTEMS. Cahill, R.T. (School of Physical Sciences, The Flinders University of South Australia, Bedford Park, Australia 5042). Phys. Rev. C 9: No. 2, 473-483 (Feb 1974).

The form, as determined by the coherence formalism, of the final-state-interaction (fsi) amplitude for three-particle breakup reactions is derived from the Faddeev equations in the case of n-d breakup. A parametrization of the Faddeev amplitudes in the fsi region is presented and interpreted. The detailed analytic form of fsi differential cross sections is obtained, showing that the most important fsi parameters are the two-particle scattering length and an effective target size, which exhibits dilation effects. Analysis of experiments with the theory implies charge symmetry of nuclear forces. (auth)

8373 ^{2}H(p, pp)n REACTION AT 23 MeV. Petersen, E.L.; Haftel, M.I.; Allas, R.G.; Beach, L.A.; Bondelid, R.O. (Naval Research Laboratory, Washington, D. C. 20375); Treado, P.A.; Lambert, J.M.; Jain, M.; Wallace, J.M. Phys. Rev. C 9: No. 2, 508-521 (Feb 1974).

A kinematically complete experiment that examines the ^{2}H(p, pp)n reaction at several quasifree angles has been performed. The results are compared with calculations performed with a program based on the code of Ebenhöh that solves the Faddeev equations with separable two-body potentials. The calculations are compared with two other programs that use a different integration contour, and the numerical differences are found to be small. The Ebenhöh code is used with three S-wave Yamaguchi potentials. Two of the potentials differ primarily in their predictions of the singlet p–p scattering length. The third potential fits the two-body np and pp scattering data below 30 MeV. The potentials give generally good fits to the breakup data, but do not provide a precise fit to the angular distribution for the quasifree peaks. The potentials themselves differ by about 30% in the predicted quasifree peaks. The calculations explicitly show that interference effects are important. It is concluded that a precise fit to the N–N data is not sufficient alone to guarantee a fit to quasifree deuteron breakup data and that the Yamaguchi form factor is inadequate for this purpose. (auth)

8374 RELATIVISTIC CORRECTIONS TO ELECTRON SCATTERING BY ^{2}H, ^{3}He, AND ^{4}He. Friar, J.L. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts). Ann. Phys. (N.Y.) 81: No. 1, 332-363 (Nov 1973).

Relativistic corrections to the scattering of electrons by a nonrelativistic nucleus are calculated, using the method of Close and Copley, and Krajcik and Foldy. Particular attention is paid to the deuteron, ^{3}He and ^{4}He. It is found that these corrections are substantially the same as those calculated by F. Gross for the deuteron. The corrections to ^{3}He have the effect of moving the diffraction minimum, as calculated in a nonrelativistic model, outward by as much as 0.32 fm^{-2}. Smaller corrections are found for ^{4}He. (auth)

8375 WHAT CAN WE LEARN FROM THREE-BODY REACTIONS? Brayshaw, D. D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 32: No. 7, 382-385 (18 Feb 1974).

A new method of analysis is applied to n-d elastic scattering and deuteron breakup in order to test the sensitivity of such reactions to details of the NN force. The results suggest that no off-shell information can be obtained from these processes which is not already implicit in the value of the n-d doublet scattering length. (auth)

8376 PRACTICAL EQUATIONS FOR THREE-PARTICLE SCATTERING CALCULATIONS. Fuda, M.G. (Natuurkundig Laboratorium der Vrije Universiteit, Amsterdam, The Netherlands). Phys. Rev. Lett. 32: No. 11, 620-622 (18 Mar 1974).

A new method is presented for solving the singular integral equations that arise in the Faddeev theory of three-particle scattering. The method is tested by means of an example and found to be practical. (auth)

8377 ^{3}He(^{3}He, 2p)^{4}He AND THE TERMINATION OF THE PROTON–PROTON CHAIN. Dwarakanath, M.R. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. C 9: No. 3, 805-808 (Mar 1974).

Following a suggestion by Fowler, Fetisov, and Kopysov, we have extended our earlier measurements of total cross section for ^{3}He(^{3}He, 2p)^{4}He to energies as low as $E_{c.m.}$ = 30 keV. The measured cross-section factors are in good agreement with the currently accepted empirical relation $S(E_{c.m.}) = (5.2 - 2.8E_{c.m.} + 1.4E_{c.m.}^2)$ MeV b. We have also searched the energy interval 14 keV < $E_{c.m.}$ < 28 keV for a narrow resonance in ^{3}He(^{3}He, 2p)^{4}He and the results of these measurements form the subject of this paper. (auth)

8378 ODD-EVEN ABSORPTION AND COULOMB-EXCHANGE EFFECTS IN THE ^{3}He + ^{4}He AND ^{3}H + ^{4}He SYSTEMS. Koepke, J.A.; Brown, R.E.; Tang, Y.C.; Thompson, D.R. (School of Physics, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. C 9: No. 3, 823-835 (Mar 1974).

Differential cross sections for ^{3}He + ^{4}He elastic scattering are calculated at c.m. energies up to 44.5 MeV using the one-channel resonating-group method. A phenomenological imaginary potential, whose strength depends on whether the relative orbital angular momentum is even or odd, is included in the calculation in order to account approximately for open reaction channels. Exchange terms which arise from the nucleon–nucleon Coulomb interaction also are included. The introduction of both the odd-even absorption and the Coulomb–exchange terms is found to lead to significantly improved agreement with experiment. In addition, the use of improved rms matter radii for ^{3}He and ^{3}H is found to yield ^{2}P$_j$ bound-state energies for the ^{3}He + ^{4}He and ^{3}H + ^{4}He systems which are more consistent with experiment than found previously. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 6726, 8370, 8453, 8511, 8539, 8557, and 8558.

8379 (COO-3274-13) NUCLEAR MOMENTS AND NUCLEAR STRUCTURE. Annual Progress Report, June 1, 1973–April 30, 1974. Madansky, L.; Lee, Y. K. (Johns Hopkins Univ., Baltimore, Md. (USA)). [nd]. Contract AT(11-1)-3274. 84p. Dep. NTIS $7.25.

The first part of this report discusses quadrupole moment measurements in single crystals, together with results on resting sites of implanted nuclear species in single crystals. A brief

review is also given of the experimental program at the Los Alamos Van de Graaff, where the feasibility of using polarized beams is being studied. The second part of the report covers work on linear gamma-ray polarization studies. It is a continuation of experimental studies of linear polarization of gamma rays from high-spin states produced in heavy-ion reactions and shows new results in the determination of parities of high-spin states reached by (HI,xn) reactions. The third section covers work on temperature spikes in solids following Coulomb excitation. Finally, studies in positron diffusion and radiative effects in heavy-ion collisions are reported. Five of the papers were separately indexed in NSA. (RWR)

For abstracts and title listings of individual papers see: 7401–7403, 8431, and 8560.

8380 (FRNC-TH-476) DETERMINATION OF A LOCAL AND NONSINGULAR FORCE APPLICABLE TO FINITE NUCLEI CALCULATIONS IN THE HARTREE–FOCK APPROXIMATION. Pires, P. (Paris-11 Univ., 91-Orsay (France)). 1973. 147p. (In French). Dep. NTIS (US Sales Only) $10.50.

Thesis.

A new local interaction is proposed which contains the same components as the Reid or Hamada-Johnston forces. The parameters of this interaction are determined in order to reproduce the data of the nucleon–nucleon system at the same time as the properties of finite nuclei (particularly the correct charge distribution radius) in the Hartree-Fock approximation, the second order energy in the nuclear matter being sufficiently small to ensure a rapid convergence of the ordinary perturbation series. Hartree-Fock calculations were effected by expanding individual wave functions using five harmonic oscillator functions as the base. The various intermediate calculations were however effected using a single oscillator base. The phase shifts were determined by resolving the Schroedinger equation and also by the phase method proposed by Calogero. Values were determined for the parameters of a local potential which explains the nucleon–nucleon phase shifts up to 250 MeV (laboratory system). At higher energies, discrepancies between theoretical values and those deduced from the MacGregor et al., analyses occur (principally for T = 0 states). They are due to the radial shape chosen and to the choice of L_{12} potential which does not appear very suitable for the reproduction of the phase shifts of the odd triplets. In addition, at high energies this potential predicts $^1P_1$ phase shifts which are too negative. Studies of the observables demonstrate that the p-p scattering data are well reproduced. In the case of n-p scattering, the calculated values differ from the experimental data as a result of an excessively repulsive odd singlet, potential. In the Hartree-Fock approximation, binding energies of the order of −3 MeV were obtained for the four spherical nuclei: ^{16}O, ^{40}Ca, ^{90}Zr and ^{208}Pb; the individual energies obtained are situated above the experimental values for oxygen and calcium. The charge radii obtained are correct; only lead presents a small discrepancy (8%) from the experimental value. (auth)

8381 (JINR–E2-7731) DETERMINATION OF NUCLEAR SPECTROSCOPIC FACTORS FROM DATA ON DIFFERENTIAL CROSS SECTIONS FOR ELASTIC NEUTRON SCATTERING ON LIGHT NUCLEI. Dubnicka, S.; Dumarais, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

The values of the coupling constants (spectroscopic factors) $_{dpn}$, ^{12}C ^{11}C n and ^{14}N ^{13}Nn were derived by means of the extrapolation of differential cross section data to the corresponding poles. Some general questions concerning the application of this method to light nuclei are considered. (auth)

8382 (JINR-P1-7784) SPECTRA OF FAST HELIUM-3, TRITIUM, AND HELIUM-4 NUCLEI PRODUCED IN INTERACTIONS OF 665 MeV PROTONS WITH LIGHT NUCLEI. Komarov, V. I.; Kosarev, G. E.; Kuz'min, E. S.; Molokanov, A. G.; Reshetnikov, G. P.; Savchenko, O. V.; Tesh, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The high energy parts of the spectra of ^3He, ^3H and ^4He nuclei from ^6Li, ^9Be and ^{12}C targets at the lab. angle of 5.5° with incident 665 MeV protons were measured. A combination of the magnetic spectrometer analysis, time-of-flight technique and energy loss measurement for particle identification was used. The experimental data were corrected for multiple Coulomb scattering effects the amount of which was experimentally estimated using deuterons from a given reaction. This reaction also was used for absolute calibration of the particle spectra. The cross sections of ^3He, ^3H and ^4He nuclei are tabulated and shown. From measurements of elementary reactions the following cross sections were found: $d\sigma/d\Omega(pd \rightarrow \pi^0\,{}^3He) = (3.2 \pm 0.4)\,\mu b/sr$ and $d\sigma/d\Omega(pd \rightarrow \pi^+\,{}^3H) = (6.8 \pm 1.0)\,\mu b/sr$. In the ^3He and ^3H spectra besides the maximum of quasielastic proton scattering on three-nucleon clusters near $P \simeq 1800$ MeV/c a significant gain of cross sections at energies kinematically corresponding to the one-pion production processes and on two-nucleon clusters at $P \simeq 1500$ MeV/c is observed. The integrated cross sections for this momentum region are given. In the ^4He spectra the cross sections with lower momentum monotonously rise without any peculiarities near $P \simeq 1600$ MeV/c due to a certain process. Possible reasons for such a behavior are discussed qualitatively. (auth)

8383 EXPERIMENTAL STUDY OF THE REACTION $\gamma + {}^{16}O \rightarrow {}^{14}N + p + n$. Mecking, B. Bonn; Univ. Bonn (1972). 99p. (In German).

Thesis.

An experiment for the study of the reaction $\gamma + {}^{16}O \rightarrow {}^{14}N + p + n$ is described. Protons are detected in a scintillation counter telescope, neutrons in a time-of-flight spectrometer. The data are analyzed, within the framework of the spectator model, as direct reaction of a photon with a p-n pair in the ^{16}O nucleus. The momentum distribution and cross section of the fission of the p-n pair are determined and compared with theoretical predictions. The kinematically uncorrelated background of multiparticle processes is excluded from the analysis. The cross section determined for the (γ,pn) reaction with ^{16}O was found to be proportional to the cross section of the d-fission and is thus in agreement with theoretical predictions. The momentum distribution of the p-n pair prior to the collision is well described by the shell model if it is assumed that nucleons from the s-shell do not contribute to the process. (GE)

8384 DETECTION OF AN ENERGY LEVEL IN ^{16}O WITH AN EXCITATION ENERGY OF 10.80 MeV. Laux, H. Mainz; Univ. Mainz (1972). 38p. (In German).

Thesis.

It is shown that there exists another energy level with natural parity in ^{16}O at 10.80 MeV. The reaction ^{15}N (d,n) ^{16}O sup(*) was used as entrance channel to determine the α-threshold of the new energy level. The excitation curve of this level was measured and was found to rise very slowly from the threshold in comparison with the γ-excitation curve for the 0^--level at 10.95 MeV which was also measured absolutely. This slow rise indicates an orbital angular momentum of the neutrons of ≥4. No data could be obtained on the quantum numbers of this state. (GE)

8385 THEORY OF INELASTIC HIGH-ENERGY DIFFRACTION SCATTERING. Berezhnoi, Yu. A.; Soznik, A. P. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 19: No. 4, 813-819(Apr 1974). (In Russian).

A model of inelastic diffraction high energy scattering of particles on nuclei is presented. The calculated differential cross sections of elastic and inelastic scattering of the 1 GeV protons on nuclei ^{12}C and ^{16}O are in good agreement with the experimental data. (auth)

8386 LOW ENERGY γ RADIATION ACCOMPANYING SCATTERING OF NEUTRONS ON NUCLEI ^{12}C. Poyarkov, V. A.; Prokopets, G. A.; Strizhak, V. I. (Kiev State Univ.). Yadern. Fiz.; 19: No. 4, 705-711(Apr 1974). (In Russian).

Experiments of two types are considered to investigate low energy γ radiation accompanying the neutron scattering of the ^{12}C nuclei. First, the fast coincidences of the γ radiation in the energy interval 20 to 150 keV with scattered neutrons were studied. Second, the energy spectrum of the "coincidence" radiation was studied. It was found that it consists of several γ lines with various widths. On the basis of the obtained information an attempt was made to construct a consistent qualitative explanation of the observed phenomenon. (auth)

8387 CROSS SECTION FOR THE DELAYED-NEUTRON YIELD FROM THE $^9Be(n,p)^9Li$ REACTION AT NEUTRON ENERGIES OF 14.5 AND 14.9 MeV. Augustson, R. H.; Menlove, H. O. (Los Alamos Scientific Lab., NM). Nucl. Sci. Eng.; 54: No. 2, 190-232(Jun 1974).

The delayed-neutron production cross section for the $^9Be(n,p)^9Li$ reaction was measured at incident neutron energies of 14.5 and 14.9 MeV. Cross-section values of 0.053 ± 0.005 and 0.210 ± 0.013 mb, respectively, were obtained. (2 tables) (auth)

8388 $^{12}C(^{12}C,n)^{23}Mg$ REACTION AROUND THE RESONANCE AT E_{cm} = 19.3 MeV. Sperr, P. (Technische Univ., Munich); Evers, D.; Rudolph, K.; Assmann, W.; Spindler, E.; Konrad, P.; Denhofer, G. Phys. Lett.; 49B: No. 4, 345-347(29 Apr 1974).

A strong selectivity of the $^{12}C(^{12}C,n)^{23}Mg$ reaction is observed in a resonance at $E_{cm}(^{12}C)$ = 19.3 MeV. The neutron spectra and n-γ coincidence measurements show evidence for population of high-spin members of the ground-state rotational band in ^{23}Mg. (auth)

8389 VISCOSITY IN HEAVY ION REACTIONS DEMONSTRATED FOR $^{16}O + ^{16}O$. Glas, D.; Mosel, U. (Univ., Giessen, Ger.). Phys. Lett.; 49B: No. 4, 301-304(29 Apr 1974).

Using the Landau–Zener approximation, probabilities were calculated for inelastic processes and fusion for head-on collisions of $^{16}O + ^{16}O$. For fusion the results show the importance of reaching a critical distance between the two ions. (auth)

8390 INVESTIGATIONS ON NUCLEAR REACTIONS INDUCED BY PROTONS AND DEUTERONS IN Be. Szegedi, S. (Kossuth Lajos Univ., Debrecen, Hungary). Acta Phys. Acad. Sci. Hung.; 34: No. 2-3, 215-223(1973).

The reaction $^{9}Be(d,n)^{10}B$ was investigated in the deuteron energy range 300 to 750 keV. The γ-yield for 717 keV photons of ^{10}B was measured and the cross sections at different energies were determined. The Gamow penetration formula gave a good fit to the shape of the experimental cross section curve. The reaction $^{9}Be(p,\gamma)^{10}B$ was investigated in the proton energy range 200 to 750 keV. Two resonances appeared in the excitation function, at E_p = 330 and 500 keV, and cross sections were determined at these energies. The angular distributions of the α_0 and α_1 particles emitted from the reaction $^{9}Be(d,\alpha)^{7}Li$ were measured in the angular range 50 to 170°. Cross sections were determined from the angular distributions in the deuteron energy range 200 to 500 keV, and the trend of the curve checked by the Gamow penetration formula. Thick targets were used for all investigations. Gammas were counted with a NaI(Tl) scintillation spectrometer and α-particles were detected with cellulose acetate (T-Cellit) track detectors. (auth)

8391 INVESTIGATION OF THE ACCURACY OF THE VARIATIONAL APPROACH CONSERVING THE NUMBER OF PARTICLES. Dolgintseva, A. I.; Fomenko, V. N. Vestn. Leningrad. Univ., Fiz., Khim.; No. 22, 43-47 (1973). (In Russian).

The accuracy of the variational approach was investigated in which the BCS states projected with respect to particle number are trial functions. The systems with the number of particles 8, 16 and 32 are considered. The ground-state energy, excitation energies of the two lowest seniority — two states and occupation probabilities of single-particle levels are calculated and compared with the exact values. (auth)

8392 DYNAMICAL MODEL OF THE ABSORPTION IN HEAVY ION SCATTERING. Fink, B.; Toepffer, C. (Univ., Frankfurt am Main). Nukleonika; 19: No. 3, 245-249(1974).

Imaginary part of the optical potential in heavy ion scattering is calculated from nucleon-nucleon cross sections with the Pauli—principle corrections to the phase space. Comparison with other methods and experiment is made. (auth)

8393 $^{16}O(^{16}O,^{12}C)^{20}Ne$ REACTION IN THE FRAMEWORK OF THE COUPLED CHANNEL FORMALISM. Krause, O.; Scheid, W.; Greiner, W. (Univ., Frankfurt am Main). Nukleonika; 19: No. 3, 267-272(1974).

The transfer reaction $^{16}O(^{16}O,^{12}C)^{20}Ne$ is treated in the coupled channel formalism. The influence of the transfer channels on the intermediate structure in the elastic excitation function is discussed. The ^{16}O and ^{20}Ne—nuclei are described in an α-cluster model. (auth)

8394 PHOTONEUTRON CROSS SECTION OF BERYLLIUM IN THE RANGE 6 MeV TO 27 MeV. Thomas, B. W. Nedlands, Australia; Western Australia Univ. (1972). vp.

Thesis.

A bremsstrahlung experiment on the photoneutron production cross section in ^{9}Be is reported. The cross section for the first time shows twenty-three maxima, which corresponds in energy and width to excited states in ^{9}Be (at 6.66, 7.40, 8.48, 9.45, 10.10, 10.76, 11.20, 12.18, 13.20, 14.12, 15.10, 15.87, 16.46, 17.3, 18.10, 18.60, 19.06, 19.98, 20.49, 21.68, 23.02, 24.58 and 25.62 MeV). As E1 transitions are dominant in photo-excitation at and below the E1 giant resonance, the likely spin and parity assignment of these states is $(1/2^+)$, $(3/2^+)$, $(5/2^+)$, the ground state of ^{9}Be having $(3/2^-)$. The results on ^{9}Be are compared with data available from other experiments in particular from ^{9}Be (e,e'), and discussed in the light of current theoretical calculations on ^{9}Be (γ,n). The relatively high resolution achieved was made possible by: changing accelerator energy with each accelerator pulse according to a repetitive program (energy sweeping); and use of a novel type multi BF_3-counter neutron detection system. Cross sections were calculated using Leiss Penfold Analysis. To ascertain that structure seen in the present ^{9}Be neutron production was not due to overinterpretation of data or generated in the bremsstrahlung-yield to cross section transformation calculation, the cross sections of the reactions $^{16}O(\gamma,n)$, $^{139}La(\gamma,n)$ and $^{209}Bi(\gamma,n)$ were measured under identical conditions, for which comparable cross section data are available from previous accurate work. The cross section scale of the present ^{9}Be neutron production cross section was fixed directly by experimental comparison with the reaction $^{2}D(\gamma,n)$. (auth)

8395 LIFETIME MEASUREMENTS BY USING CHARGED-PARTICLE CAPTURE REACTIONS. Lieb, K. P. (Univ., Cologne). pp 41-60 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

A survey is given on experimental techniques and recent results of lifetime measurements by use of proton- and α-particle-induced capture reactions in targets with $A \lesssim 50$. Most of the data were obtained by means of either the Doppler-Shift-Attenuation (DSA) or the delayed-coincidence method, which therefore are reviewed here in some detail. Emphasis is put on difficulties inherent to DSA measurements, viz., choice and preparation of target and/or backing, gain drifts of the Ge(Li) detector and associated electronics, analysis of Doppler-broadened γ-ray line shapes, evaluation and extrapolation of the slowing down time from range or stopping power data, and straggling of the recoiling nuclei due to ion–ion collisions. Target/backing combinations are suggested which could provide more precise lifetimes by comparing them with the values obtained from other methods (Coulomb excitation, resonance fluorescence, DSA involving heavy-ion reactions). In turn, the DSA method in connection with capture reactions can be applied to studying the stopping process of heavy ions in different materials. The type of nuclear-structure information which has been extracted from the recently measured lifetimes (and other properties) of bound states and very narrow resonances in the 2s–1d shell is illustrated. As a first example, the capture of charged particles into high-spin members of rotational bands in $^{18}F(J^\pi = 6^+, K = 1)$, $^{25}Al(J^\pi = 5/2^+, K = 1/2)$, and $^{29}Si(J^\pi = 1/2^+, K = 1/2)$ is mentioned. Another topic is the identification of antianalog states in ^{35}Cl, ^{38}Ar, and ^{39}K fed by strong M1 transitions from their respective analog resonances. (11 figures, 3 tables, 66 references) (auth)

8396 DIRECT-CAPTURE STUDIES AS A TOOL IN NUCLEAR SPECTROSCOPY. Rolfs, C. (Univ. of Toronto). pp 197-231 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

The γ rays following the capture of protons on light nuclei (^{12}C to ^{24}Mg) were studied over a wide range of bombarding energies (0.3 to 3.0 MeV). The observed cross sections consist of a small nonresonant (direct-capture) yield upon which the various known resonances in the reaction are superposed. The direct-capture cross section (≈1 to 10 μb) varies slowly with bombarding energy. The proton capture proceeds in the residual nuclei to all states which are known to be of predominantly single-particle structure. The angular distributions of the direct-capture γ rays to states which contain components of (target + ($p_{1/2}$, $s_{1/2}$, or $d_{5/2}$) single-particle orbits) all show a very striking isotropic, $\sin^2\theta$, or $1 + 1/4 \sin^2\theta$ form, respectively. These angular distributions change very little with beam energy. All these observations can be very well explained by the extranuclear model of Christy and Duck, [R. F. Christy, I. Duck, Nucl. Phys.; 24: 89(1961)]. The fit of the experimental data with this model provides additional information on the reduced widths of the various bound states of the final nuclei. This latter information can be compared with results from stripping reactions or with predictions of shell-model calculations. (14 figures, 3 tables) (auth)

8397 RADIATIVE CAPTURE OF DEUTERONS, TRITONS, AND ^{3}He PARTICLES. Suffert, M. (Centre de Recherches Nucleaires, Strasbourg). pp 249-269 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna; Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

The radiative capture of deuterons, tritons, and ^{3}He particles ((c,γ) reactions) has not yet been studied very extensively but presents several points of interest. Their Q values are usually rather high (10–25 MeV), so that with moderate incident energies (<5 MeV) high excitation energies can be studied, in particular, the giant dipole resonance (GDR) region. They are useful to determine the cross sections for photoemission of composite particles. They help to identify n-particle–n-hole states in the GDR region, which seem to play an important role in the origin of the fine structure of the GDR of light nuclei. The mechanism of (c,γ) reactions is not yet well understood. For (d,γ) reactions in light nuclei, direct or semidirect capture mechanisms, sometimes in-

volving a two-step process, seem necessary to explain the observed cross section, but in several cases the compound-nucleus theory is sufficient. (c,γ) reactions on very light nuclei constitute a special category. Their cross sections are relatively high, and they are used extensively to investigate the structure of very light nuclei. Finally, (c,γ) reactions are used to excite high-T states. The experimental study of (c,γ) reactions is relatively difficult because of the low cross sections and high backgrounds. Different methods are described with emphasis on the one-crystal NaI spectrometer, which in many cases permits identification of the final states. Experimental studies of radiative capture of composite particles which have come to the author's knowledge are summarized in tables. (7 figures, 3 tables, 90 references) (auth)

8398 POLARIZED $(\vec{p},\gamma)$ REACTION. Hanna, S. S. (Stanford Univ., CA). pp 293-323 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

The polarized $(\vec{p},\gamma)$ reaction was applied to the study of the giant E_1 resonance in ^{4}He, ^{12}C, ^{16}O, ^{20}Ne, ^{28}Si, and ^{90}Zr. It is shown that, with the exception of ^{12}C and ^{28}Si, the polarized and unpolarized measurements fix the amplitudes and relative phases of the proton partial waves. (19 figures, 1 table) (auth)

8399 ALPHA WIDTHS IN LIGHT NUCLEI. Arima, A. (State Univ. of New York, Stony Brook). pp 47-57 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

Alpha spectroscopic factors in light nuclei are discussed on the basis of the harmonic oscillator shell model. The calculated factors are applied to the alpha decay widths of ^{20}Ne. The effect of 0p−0h, 2p−2h, and 4p−4h mixture on the probability of finding an alpha particle in the surface of ^{16}O is also discussed. (2 figures, 4 tables) (auth)

8400 EVIDENCE FOR A GIANT QUADRUPOLE RESONANCE IN ^{16}O. Hanna, S.S.; Glavish, H.F.; Avida, R.; Calarco, J.R.; Kuhlmann, E.; LaCanna, R. (Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 32: No. 3, 114-117 (21 Jan 1974).

Measurements on the polarized-proton capture reaction ^{15}N(p, γ_0)^{16}O indicate a broad E2 resonance which lies above the giant E1 resonance of ^{16}O. The measurements show that the E2 radiation for the (γ, p_0) channel of ^{16}O exhausts approximately 30% of the quadrupole sum rule. (auth)

8401 SPINS OF THE 3.854-MeV AND 7.026-MeV LEVELS IN ^{17}F FROM ^{16}O$(\vec{p}, p)^{16}$O. Darden, S.E.; Hiddleston, H.R. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 9: No. 2, 800-801 (Feb 1974).

The spin and parity of the 7.026-MeV level in ^{17}F has been determined to be $5/2^-$ on the basis of excitation-function measurements of ^{16}O$(\vec{p}, p)^{16}$O. The $5/2^-$ assignment to the 3.854-MeV level was also confirmed. (auth)

8402 NEW MASS-TABLE PARAMETERS FOR NUCLEI $Z \leq 16$. Thibault, C.; Klapisch, R. (Laboratoire René-Bernas du Centre de Spectrométrie, Nucléaire et de Spectrométrie de Masse, 91-Orsay, France). Phys. Rev. C 9: No. 2, 793-797 (Feb 1974).

Recent measurements of the masses of ^{11}Li and ^{14}B and a better fitting procedure result in a new set of parameters for the Garvey et al. mass table. A better agreement is obtained for the limit of stability as ^{14}Be and ^{19}C are now predicted to be bound. (auth)

8403 SELF-CONSISTENT CORE POLARIZATION NEAR ^{16}O. Kirson, M.W. (Department of Nuclear Physics, Weizmann Institute of Science, Rehovot 76322, Israel). Ann. Phys. (N.Y.) 82: No. 2, 345-368 (Feb 1974).

Self-consistent fully-screened core polarization is evaluated by use of the mutually consistent particle-hole, particle-phonon, hole-phonon, and core-to-2p2h vertices. The sensitivity of the results to changes in unperturbed single-particle energies and in reaction matrix elements is tested, and it is found that the usual effects of collective enhancements and screening reductions persist. The final results are remarkably stable, even though individual renormalization effects show strong pathologies. It is argued that the RPA is not a good method for treating vibrations of the nuclear core. The self-consistent vertices are applied to calculations of the hole-hole effective interaction, of shell breaking, and of E2 effective charges, and it is shown that all the renormalization effects found in the particle-particle effective interaction show up in these other quantities as well. The conclusion is that self-consistent core polarization is too weak to account for significant renormalizations of effective operators. (auth)

8404 MULTIPLE DIFFRACTIVE ANALYSIS OF ELASTIC AND INELASTIC SCATTERING BY 1 GeV PROTONS ON ^{12}C, ^{58}Ni, AND ^{208}Pb. Alexander, Y.; Rinat (Reiner), A.S. (Department of Physics, The Weizmann Institute of Science, Rehovot, Israel). Ann. Phys. (N.Y.) 82: No. 2, 301-325 (Feb 1974).

Recent elastic and inelastic scattering experiments of 1 GeV protons on ^{12}C, ^{58}Ni, and ^{208}Pb have been analyzed using multiple diffractive scattering theory. Elastic angular distributions have been calculated, including pair correlations in many-particle densities. There is evidence from the Ni and Pb data for the presence of correlations, but some evaluated correlation corrections do not produce detailed agreement. It is shown that the Glauber series for coherent inelastic scattering can be approximately summed to yield an eikonal form of the DWIA. In particular the smaller angle parts of the inelastic distributions are well described in this approximation. The expression for the summed incoherent inelastic cross section is considered as a sum rule. It is found that for ^{12}C the excitation of the three lowest excited states exhaust $\lesssim 25\%$ of the sum rule up to $-t \lesssim 1$ fm^{-2}. For larger t quasi-elastic knock-out largely exhausts the sum rule. (auth)

8405 WHERE IS THE $(2S_{1/2})^2$ T = 1 STRENGTH IN MASS 18? Nero, A.V.; Adelberger, E.G. (Stanford University, Stanford, California 94305); Dietrich, F.S.; Walker, G.E. Phys. Rev. Lett. 32: No. 11, 623-626 (18 Mar 1974).

A doublet at 4.5-MeV excitation energy in ^{18}Ne has been studied via the reactions ^{16}O(^{3}He, n)^{18}Ne and ^{20}Ne(p, t)^{18}Ne. The states are found to have excitation energies of 4.518 ± 0.008 and 4.590 ± 0.008 MeV with spin and parity 1^- and 0^+, respectively. The difference between the excitation energy of the 0^+ state and that of the analogous state at 5.34 MeV in ^{18}O gives strong evidence for the predominantly $s_{1/2}^2$ character of the state. (auth)

8406 IDENTIFICATION OF ANALOG PAIRS IN ^{13}C AND ^{13}N BY MEANS OF THE ^{10}B(^{6}Li, ^{3}He)^{13}C AND ^{10}B(^{6}Li, t)^{13}N REACTIONS. Holbrow, C.H. (Department of Physics and Astronomy, Colgate University, Hamilton, New York 13346); Bingham, H.G.; Middleton, R.; Garrett, J.D. Phys. Rev. C 9: No. 3, 902-909 (Mar 1974).

The ^{10}B(^{6}Li, t)^{13}N and ^{10}B(^{6}Li, ^{3}He)^{13}C reactions were induced with $E_{^6Li} = 18$ MeV in order to test the assignment of mirror pairs by direct comparison of the resulting spectra. The technique appears to be reliable up to excitations of ~10 MeV for these cases. Some new analog pairs are suggested, and a hitherto unreported state is identified at 9.00 MeV in ^{13}N. (auth)

8407 (p, pn) REACTIONS ON LIGHT NUCLEI AT 46 MeV. Miller, C.A.; Watson, J.W.; Bonbright, D.I.; Wilson, F.J.S.; Wells, D.O. (Cyclotron Laboratory, Department of Physics, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2). Phys. Rev. Lett. 32: No. 12, 684-687 (25 Mar 1974).

The reactions ^{6}Li(p, pn)^{5}Li, ^{9}Be(p, pn)^{8}Be, and ^{13}C(p, pn)^{12}C, as well as the reaction ^{6}Li(p, 2p)^{5}He, have been studied at 46 MeV. The plane-wave impulse approximation (PWIA) has been used for a preliminary analysis. The ^{9}Be and ^{13}C cross sections show a pronounced p-state minimum near zero recoil momentum as expected in the PWIA. No such minimum is seen for either reaction on ^{6}Li. The angular dependence of the three (p, pn) reactions departs strongly from PWIA predictions. (auth)

8408 OBSERVATION OF AN ANOMALOUS ANGULAR DISTRIBUTION IN THE SINGLE-NUCLEON-TRANSFER REACTION ^{12}C(^{14}N, ^{13}N)^{13}C AT 100 MeV. DeVries, R.M.; Zisman, M.S.; Cramer, J.G.; Liu, K. (University of Washington, Seattle, Washington 98195); Becchetti, F.D.; Harvey, B.G.; Homeyer, H.; Kovar, D.G.; Mahoney, J.; von Oertzen, W. Phys. Rev. Lett. 32: No. 12, 680-683 (25 Mar 1974).

The reaction ^{12}C(^{14}N, ^{13}N)^{13}C has been studied at a bombarding energy of 100 MeV. The measured differential cross sections have been compared with exact finite-range distorted-wave Born approximation calculations including recoil. The angular distribution of the reaction populating the $2s_{1/2}$ state in ^{13}C at 3.09 MeV shows pronounced oscillations which are out of phase with those of the predicted angular distribution. (auth)

8409 RESONANCE IN THE REACTION ^{12}C(^{12}C, p)^{23}Na AT $E_{c.m.} = 19.3$ MeV. Van Bibber, K.; Cosman, E.R.; Sperduto, A.; Cormier, T.M.; Chin, T.N. (Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Hansen, O. Phys. Rev. Lett. 32: No. 12, 687-690 (25 Mar 1974).

Excitation functions of the fifteen most strongly populated states ($9 < E_x < 17$ MeV) in the reaction ^{12}C(^{12}C, p)^{23}Na have been studied using a magnetic spectrograph. A resonance structure was observed for transitions to several final states at $E_{c.m.} = 19.3$ MeV with $\Gamma_{c.m.} \simeq 500$ keV. Two particle-bound states in ^{23}Na at 9.08 and 9.84 MeV are particularly strongly populated in the reaction ^{12}C(^{12}C, p) at the resonant energy. The further study of the structure of these states may provide an important clue to the nature of the observed ^{12}C + ^{12}C resonance. (auth)

8410 NUCLEAR SHOCK WAVES IN HEAVY-ION COLLISIONS. Scheid, W.; Müller, H.; Greiner, W. (Institut für Theoretische Physik der Universität Frankfurt, Frankfurt am Main, Germany). Phys. Rev. Lett. 32: No. 13, 741-745 (1 Apr 1974).

It is shown that nuclear matter is compressed during the encounter of heavy ions. If the relative velocity of the nuclei is larger than the velocity of first sound in nuclear matter (compression sound for isospin T=0), nuclear shock waves occur. They lead to densities which are 3–5 times higher than the nuclear equilibrium density ρ_0, depending on the energy of the nuclei. The implications of this phenomenon are discussed. (auth)

8411 EVIDENCE FOR E2 AND M1 RADIATION IN THE GIANT-DIPOLE-RESONANCE REGION OF ^{15}N. Weller, H.R. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32601 and Triangle Universities Nuclear Laboratory, Durham, North Carolina 27706); Roberson, N.R.; Rickel, D.; Cameron, C.P.; Ledford, R.D.; Clegg, T.B. Phys. Rev. Lett. 32: No. 4, 177-180 (28 Jan 1974).

A study of the reaction ^{14}C(p, γ)^{15}N has been performed using a polarized proton beam. The results show that E2 and M1 radiations are significant in the giant-dipole-resonance region of ^{15}N. The measured analyzing power is combined with cross-section measurements to obtain J^π values and both relative strengths and phases of the T-matrix elements. (auth)

8412 STUDY OF DEUTERON-CLUSTER DEFORMATION USING THE REACTION ^{6}Li(d, tp)^{4}He. Grossiord, J.Y.; Coste, C.; Guichard, A.; Gusakow, M.; Jain, A.K.; Pizzi, J.R. (Institut de Physique Nucléaire, Université Claude Bernard Lyon-I, and Institut National de Physique Nucléaire et de Physique des Particules, 69621 Villeurbanne, France); Bagieu, G.; de Swiniarski, R. Phys. Rev. Lett. 32: No. 4, 173-176 (28 Jan 1974).

The reaction ^{6}Li(d, tp)^{4}He has been studied for two values of residual ^{4}He momentum ($\vec{k}_\alpha$ = 0 and −30 MeV/c). The shift of the first minimum in the angular distribution of the reaction ^{6}Li(d, tp)^{4}He, for fixed $\vec{k}_\alpha$, with respect to the first minimum in the angular distribution of the reaction d(d, t)p, has been used to investigate the structure of the d cluster in the ^{6}Li nucleus. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 6726, 8391, 8395, 8397–8399, 8402, 8405, 8409, 8453, 8511, and 8557.

8413 (KFTI-73-23) MULTIPOLE FORM FACTORS FOR ELASTIC ELECTRON SCATTERING BY ^{27}Al, ^{39}K, AND ^{59}Co NUCLEI. Likhachev, V. P.; Afanas'ev, N. G.; Nemashkalo, A. A.; Savitskii, G. A.; Khvastunov, V. M.; Yaroshevskii, L. D. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1973. 28p. (In Russian). INIS.

Within the framework of the one-particle shell model, analytical expressions were obtained for the electric and magnetic multipole form factors of ^{27}Al, ^{39}K, and ^{59}Co. A comparison was made of the calculated multipole form factors and the available experimental data. The value of the M7 magnetic moment of ^{59}Co was derived. (6 figures) (tr-auth)

8414 (STI/PUB-365) CHARGED-PARTICLE-INDUCED RADIATIVE CAPTURE. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, Austria, October 9–13, 1972. (International Atomic Energy Agency, Vienna (Austria)). Feb 1974. 389p. (CONF-7210117-). IAEA $17.00.

Separate abstracts were prepared for each of the papers in this volume. (RWR)

For abstracts of individual papers see: 7503, 8370, 8395–8398, 8421–8426, 8439, 8448, 8465, 8532, and 8573.

8415 TRANSITION PROBABILITIES OF LOW-LYING NUCLEAR PROPERTIES OF ^{35}Cl. Van Reenen, R. J. Stellenbosch, S. Afr.; Stellenbosch Univ. (1972). 140p. (In Afrikaans). Atomic Energy Board, Pretoria.

Thesis.

The motivation for the experimental project and a brief review of available methods for the determination of nuclear lifetimes are given. An up to date summary of the available experimental data for the ^{35}Cl nucleus is included. The results of a preliminary investigation of nuclear properties of ^{35}Cl by means of the ^{35}Cl(p, p'γ) and ^{34}S(p,γ) reactions are reported. This includes 91 (p,γ) resonances for incident proton energies between 2 and 3.47 MeV and the level energies and quantitative decay schemes of the first six excited states of ^{35}Cl. Possible adaptions of the resonance absorption technique to permit its application for the determination of lifetimes of lower lying nuclear levels are also discussed. The experimental apparatus and procedure for the measurement of nuclear lifetimes by a coincident version of the Doppler shift attenuation method is described. The analysis of the measured Doppler shifts is considered. Special attention is given to factors which might lead to errors in the derived values of lifetimes. This includes corrections for finite detection geometry, experimental stopping power data, finite target thicknesses, excitation fluctuation throughout the target thickness and the effect of excited residual nuclei escaping from the target into the target chamber vacuum. Results of the lifetime measurements of ^{35}Cl levels are presented. In addition, the mean life time of the 1.013 MeV level of ^{27}Al, which was measured during the testing of the experimental and analytical procedures subsequently employed in the ^{35}Cl lifetime measurements, is given. The measured ^{35}Cl lifetime values are used as comparative data in the determination of the success of shell model calculations of transition probabilities for this nucleus. The results of the shell model calculations appear to indicate that the inclusion of a positive nucleon charge increment can successfully compensate for the limited shell model space used in the theoretical calculations. (auth)

8416 INVESTIGATION OF LEVEL DENSITY FOR SOME NUCLEI OF sd SHELL BY MEANS OF THE ENERGY SPECTRA OF THE (n,p) REACTIONS AT THE NEUTRON ENERGY OF 14.1 MeV. Kovrigin, B. S.; Klochkova, L. I. (Leningrad Technological Inst.). Yadern. Fiz.; 19: No. 4, 715-724 (Apr 1974). (In Russian).

By means of the counter telescope the spectra are measured of protons produced in the (n,p) reactions at interaction of neutrons with energy of 14.1 MeV with nuclei ^{27}Al, ^{28}Si, ^{31}P, ^{35}Cl, ^{39}K, ^{52}Cr, under some of the angles: 7, 45, 60 and 80°. The nuclear temperature and the level density parameter a are determined from the spectra both in the region of applicability of the superfluid model and in the Fermi-gas region. Comparison of the obtained values of the parameter a indicates that representations in the approximation of constant temperature at superfluid nuclear state is preferable. (auth)

8417 j DEPENDENCE OF THE PROTON ANGULAR DISTRIBUTIONS IN THE STRIPPING REACTIONS ON NUCLEI ^{24,26}Mg AND ^{90,92,94}Zr. Zaika, N. I.; Kibkalo, Yu. V.; Levshin, E. B.; Mokhnach, A. V.; Nemets, O. F.; Semenov, V. S.; Tokarev, V. P.; Shityuk, V. A.; Shmarin, P. L. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 19: No. 4, 740-747 (Apr 1974). (In Russian).

Angular distributions of protons from the (d,p) reactions on nuclei with filling of 1d(^{25}Mg) and 2d(^{90}Zr, ^{92}Zr, and ^{94}Zr) shells are studied at the energy of 13.6 MeV. The j dependence of the angular distribution shape was detected for transitions with l_n = 2. The dependence has different properties in these nuclear regions. The results are analyzed on basis of the distorted-wave method with account of the spin-orbit interaction in the incoming and outgoing channels of the reaction. (auth)

8418 (^{16}O, ^{15}N) REACTION AT FORWARD ANGLES. Ball, J. B.; Hansen, O.; Larsen, J. S.; Sinclair, D.; Videbaek, F. (Univ., Copenhagen). Phys. Lett.; 49B: No. 4, 348-350 (29 Apr 1974).

Angular distributions for the (^{16}O, ^{15}N) reaction on ^{26}Mg at 35 MeV, ^{30}Si at 45 MeV, and ^{48}Ca at 56 MeV, were measured at scattering angles down to 4° in the laboratory system. Diffraction-like structure is observed at forward angles in striking contrast to the smooth "bell-shaped" peak which occurs at larger angles and is generally associated with heavy-ion transfer reactions. The sensitivity of this forward-angle structure to the description of the reaction process is discussed. (auth)

8419 SINGULARITY IN E1 MATRIX ELEMENTS AT THE NEUTRON THRESHOLD: EVIDENCE FROM (d,p)−(n,γ) CORRELATIONS. Kopecky, J. (Reactor Centrum, Petten, Netherlands); Spits, A. M. J.; Lane, A. M. Phys. Lett.; 49B: No. 4, 323-324 (29 Apr 1974).

There are several independent effects which tend to suppress correlations of the (d,p)−(n,γ) type. When a nearperfect correlation is found, as in the case of ^{37}Cl with thermal capture, it follows that all the effects are small. This has important implications, such as showing that the dominant thermal capture process can be "direct", thereby settling a long debate. Further, the data establishes the E_γ^{-1} singularity in E1 matrix elements for thermal capture that was derived theoretically in 1960. (auth)

8420 ^{23}Na(d,p)^{24}Na REACTION AT DEUTERON ENERGIES 670 AND 620 keV. Valek, A. (Inst. of Nuclear Research, Debrecen, Hungary). Acta Phys. Acad. Sci. Hung.; 34: No. 2-3, 179-186 (1973).

Angular distributions and absolute cross sections of proton groups p_0, p_1, p_2, p_3 + p_4 and p_5 + p_6 from the reaction ^{23}Na(d,p)^{24}Na were measured at E_d = 670 and 620 keV. The experimental data are analyzed in terms of Legendre polynomials and DWBA method.

The DWBA calculations reproduced the angular distributions of proton groups $p_2 + p_4$ and $p_3 + p_5$. (auth)

8421 CHARGED-PARTICLE RADIATIVE CAPTURE AS A TOOL IN NUCLEAR-STRUCTURE STUDIES. Endt, P. M. (Rijksuniversiteit, Utrecht). pp 3-16 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

Charged-particle capture is compared with other spectroscopically useful reactions like direct reactions, neutron capture, and resonance reactions involving a secondary charged particle. The special advantages and disadvantages of (p,γ) and (α,γ) DSA measurements are also discussed. As examples, recent investigations in Utrecht of the $^{23}Na(\alpha,\gamma)^{27}Al$, $^{27}Al(\alpha,\gamma)^{31}P$ and $^{35}Cl(p,\gamma)^{36}Ar$ reactions are quoted. A survey is given on the strengths of γ-ray transitions between bound states in self-conjugate nuclei. The upper limits derived for, e.g., T-retarded M1-transitions can be used as spectroscopic tools for J^π and T determinations. Finally, some remarks are made on the theoretical interpretation of energy spectra in the s–d shell, with special emphasis on many-particle shell-model calculations. Calculations of magnetic moments are given as an illustration. (1 table) (auth)

8422 NUCLEAR SPECTROSCOPY STUDIES BY MEANS OF THE (p,γ) REACTION. Meyer, M. A. (Potchefstroom Univ., South Africa). pp 17-40 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

The experimental requirements for (p,γ) research by means of low-energy accelerators are discussed. Measurements such as proton energies, strengths and widths of resonances, γ decay of resonances and bound levels, Q values, energies of bound levels, lifetimes, and the determination of spins are reviewed. Some new results are presented. The future of (p,γ) research is discussed. (3 figures, 5 tables) (auth)

8423 ANALYSIS OF THE DOPPLER-SHIFT ATTENUATION METHOD AT LOW RECOIL VELOCITIES. Vakselj, M. (Univ. of Ljubljana, Yugoslavia). pp 61-70 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

When using the Doppler-shift attenuation method to measure very short nuclear lifetimes, one should take into account the fact that, at ion velocities less than about 0.002c, the usual assumption of a continuous slowing-down of the ion is not well justified. When the recoiling ion and the atoms in the target are nearly of the same mass, the ions will be effectively stopped after a very few elastic collisions. Calculations using the discontinuous slowing-down model are made for the example $^{27}Al(p,\gamma)^{28}Si$, at a proton energy of 1.3 MeV. Examples are given of γ-ray line shapes for hard-sphere and for LSS potentials and for the Blaugrund model, for a lifetime $\tau = 10^{-13}$ s. Finally, a comparison is made with experiment, by using the 2.84-MeV γ line in ^{28}Si, which demonstrates the validity of the new model. (7 figures) (auth)

8424 CHARGED-PARTICLE RADIATIVE-CAPTURE STUDIES BY ANGULAR-CORRELATION MEASUREMENTS: METHODS, RULES, AND LIMITATIONS. Ingebretsen, F. (Univ. of Oslo). pp 71-97 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

Theoretical expressions for gamma-ray triple and double angular correlations in a compact notation are summarized. The notation is well suited as a basis for efficient computer programs. Various methods of observations and data analysis of triple angular correlations are reviewed. The alignment of the initial state can be described in terms of population parameters or in terms of statistical tensors, and it is shown that statistical tensors generally are the better parameters to use. The extreme physically acceptable limits for all statistical tensors are given. The double angular correlation (distribution) is discussed in detail. It is shown that some angular distributions cannot determine the spins of the involved levels uniquely. Possible experiments to resolve some of these ambiguities are proposed. Finally, a technique for measuring particle–gamma angular correlations by a study of Doppler-broadened line shapes in a Ge(Li) detector is reviewed. (15 figures, 3 tables) (auth)

8425 NUCLEAR-SPECTROSCOPY STUDIES BY PROTON RADIATIVE CAPTURE. Kopanets, E. G. (Physical-Technical Inst., Kharkov). pp 101-119 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

Methods for obtaining, storing, and processing experimental data from proton radiative capture reactions are described. Examples are given illustrating the (p,γ)-reaction method from the viewpoint of extracting nuclear-spectroscopy information on bound and resonant states of light nuclei. (12 figures, 5 tables) (auth)

8426 GAMMA DECAY OF THE HIGH-ISOSPIN LEVELS OF NUCLEI. Hanna, S. S. (Stanford Univ., CA). pp 159-194 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

A survey is made of the high-isospin states in nuclei, with particular emphasis on the $T_>$ levels and their gamma decay. Selection rules, sum rules, isospin mixing, beta decay, and the nature of the levels are discussed. (29 figures, 6 tables) (auth)

8427 MEASUREMENTS OF THE LIFETIMES OF CORRESPONDING LEVELS IN ISOSPIN MULTIPLETS. Bizzeti, P. G. (Technische Univ., Munich). pp 58-68 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

Experimental results on the strength of analog electromagnetic and weak transitions are briefly reviewed, in particular, the strength of M1 and allowed Gamow–Teller transitions. The actual meaning of the comparison (from a theoretical point of view), the present limits of reliability, and the experimental results obtained in recent years by different groups (especially the ones at Florence and Padua) are discussed. (6 figures, 2 tables) (RWR)

8428 STUDY OF THE $^{26}Mg(^3He, p)^{28}Al$ REACTION. Betts, R.R.; Fortune, H.T. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Pullen, D.J. Phys. Rev. C 9: No. 2, 589-597 (Feb 1974).

An analysis of the $^{26}Mg(^3He, p)^{28}Al$ reaction at a bombarding energy of 18 MeV has enabled the identification of 80 levels in ^{28}Al below $E_x = 8.65$ MeV. A distorted-wave analysis of the angular distributions of these transitions has led to unique spin-parity assignments for 8 levels. Limits have been set on the spins and parities of 17 states. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 8380, 8397, 8402, 8404, 8413, 8416, 8418, 8448, 8453, 8454, 8463, 8485, 8539, 8544, and 8556.

8429 (CEN-N-1666) MICROSCOPIC THEORY OF TRANSFER REACTIONS BETWEEN HEAVY IONS. Bonche, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service de Physique Theorique). Oct 1973. 141p. (In French). Dep. NTIS (US Sales Only) $10.25.

Thesis. Submitted to Paris Univ.

An attempt was made to determine a transition amplitude which could be expressed directly using wave functions from the shell model for various nuclei. The generator coordinate method was successfully used for this purpose, the drawback of this method being the neglect of the recoil approximation. Several applications to recent experiments are presented. The calculations indicate the importance of the contribution of each of the possible internal states of the transferred fragment and enable a system of selection rules to be established. These selection rules are related to the angular momentum of single particle states populated by the reaction. (auth)

8430 (CONF-740402-25) MEASURED AND EVALUATED FAST NEUTRON CROSS SECTIONS OF NICKEL AND COBALT. Smith, A.; Guenther, P.; Smith, D.; Whalen, J. (Argonne National Lab., Ill. (USA)). 1974. 10p. Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The provision of evaluated fast-neutron data of nickel and cobalt by experimental and theoretical means is outlined with emphasis on CTR relevance. New experimental results are presented including total cross sections, elastic and inelastic scattering cross

sections, and (n,p) cross sections. These measured values, previously reported experimental information, and physical theory are utilized to provide comprehensive evaluated neutron data files in the ENDF/B format. (4 figures) (auth)

8431 (COO-3274-13, pp 39-49) GAMMA-RAY LINEAR POLARIZATION MEASUREMENTS FOLLOWING HEAVY-ION BOMBARDMENT. Kim, J. S.; Lumpkin, A. H.; Lee, Y. K. [nd].

In nuclear moments and nuclear structure. Annual progress report, June 1, 1973–April 30, 1974.

8432 LOW-LYING LEVELS IN ^{45}Sc. Rust, N. J. A. Stellenbosch, S. Afr.; Stellenbosch Univ. (1972). 121p. (In Afrikaans). Atomic Energy Board, Pretoria.

Thesis.

The experimental determination of some properties of low lying levels in ^{45}Sc and the theoretical interpretation of these properties in terms of the excited core model, are described. An investigation of the reaction ^{44}Ca(p,γ)^{45}Sc is discussed. A tabulation of observed resonances in the gamma excitation curve is followed by a short discussion of the problems which were encountered in using this reaction as an experimental tool to obtain sufficient information on the low lying levels in ^{45}Sc. The elimination of most uncertainties regarding spin values of some states in ^{45}Sc was effected by means of a Hauser-Feshbach analysis in a study of the reaction ^{45}Sc(p,p')^{45}Sc. This is tabulated. The results obtained for the energies and branching ratios of low lying states in ^{45}Sc are given. A general discussion of the Doppler shift attenuation method is given, with special reference to the coincidence version of this technique. This method was used to determine the mean lives of four excited states in ^{45}Sc. The states were excited by means of the reaction ^{45}Sc(p,p'γ)^{45}Sc in all these experiments. Results are given in a table. Reduced transition probabilities for E2-radiation derived from these results, are compared with published values. The determination of the mean lifetime of the 720.4 keV state in ^{45}Sc excited by the resonance fluorescence technique is described. The angular distribution of the resonantly scattered quanta was measured with the object of determining the spin of the state. The lifetime was found to be $\tau = (120 \pm^{11}_{10})$ fs. The main features of the excited core model are given. The coupling of the odd proton in ^{45}Sc to the first excited (2^+) state of ^{44}Ca gives rise to the multiplet mentioned previously. The B(E2) values of transitions from these levels to the ground state, as obtained from this model, show good agreement with experimental values derived from measured lifetimes. Details are given in tabular form. (auth)

8433 PROTON PHOTOPRODUCTION ON ^{40}Ca NUCLEUS AT THE BREMSSTRAHLUNG MAXIMUM ENERGY OF 340 MeV. Grishaev, I. A.; Lapin, N. I.; Pugachev, G. D.; Ranyuk, Yu. N. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 19: No. 4, 725-726(Apr 1974). (In Russian).

At the bremsstrahlung maximum energy of 340 MeV the photoproduction cross sections are measured on ^{40}Ca nucleus for the protons with kinetic energies from 30 up to 160 MeV, emitted under the angles of 60, 90 and 120° in lab. sys. The nuclear photoemulsion method was used. The proton energy spectra are in reasonable agreement with the cascade model calculations. (auth)

8434 NEUTRON-INDUCED GAMMA-RAY PRODUCTION IN TITANIUM FOR INCIDENT-NEUTRON ENERGIES OF 4.9, 5.4, AND 5.9 MeV. Dickens, J. K. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 54: No. 2, 191-196(Jun 1974).

Interactions of neutrons with titanium were studied by measuring gamma-ray-production cross sections. For a sample of natural titanium, spectra were obtained for incident-mean-neutron energies E_n = 4.9, 5.4, and 5.9 MeV with gamma-ray detector systems utilizing coaxial Ge(Li) detectors. Nearly monoenergetic neutrons were obtained from the D(d,n) reaction using deuterons obtained from the (pulsed) Oak Ridge National Laboratory 5-MV Van de Graaff accelerator. Time of flight was used with the detector to discriminate against pulses due to neutrons and background radiation. Gamma-ray identification was aided by obtaining several spectra for samples enriched in the isotopes ^{46}Ti and ^{48}Ti, and new information on the level structures of these two isotopes was obtained. Absolute differential cross sections for production of gamma rays were obtained and are reported. These cross sections are compared, where possible, with previous (n,n') measurements and with cross sections derived from the current ENDF/B evaluation. (1 figure, 3 tables) (auth)

8435 NEW DELAYED PROTON PRECURSOR: CHROMIUM-45. Jackson, K. P. (Univ. Toronto); Hardy, J. C.; Schmeing, H.; Graham, R. L.; Geiger, J. S. Phys. Lett.; 49B: No. 4, 341-344 (29 Apr 1974).

The new $T_z = -\frac{1}{2}$ isotope, ^{45}Cr, was produced by the ^{32}S(^{16}O,3n) ^{45}Cr reaction. Its half-life was measured to be 50 ± 6 ms. A single β-delayed proton group with center-of-mass energy 2.10 ± 0.05 was observed, corresponding to the decay of the lowest $T = \frac{3}{2}$ state in ^{45}V. (auth)

8436 CREATIVE FACTOR AND TWO-STEP PROCESSES. Toyama, M. (Univ., Tokyo). Phys. Lett.; 49B: No. 4, 311-314 (29 Apr 1974).

Some questions concerning the creative factor contained in perturbation theory of two-step processes are examined. It is shown that perturbation theory is justifiable by deriving the propagator by means of a projection method and using a generalized optical potential. (auth)

8437 HIGH-SPIN STATES IN THE $1f_{\frac{7}{2}}$ SHELL STUDIED BY HEAVY-ION INDUCED COMPOUND REACTIONS. Signorini, C. (Technische Univ., Munich). pp 77-89 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

Recent results from "in-beam γ-ray spectroscopy" leading to some high-spin states of nuclei in the $1f_{\frac{7}{2}}$ shell are presented and discussed. Some features of this type of spectroscopy are also described, in connection with the experimental techniques adopted and the interpretation of the experimental results. It is suggested that the nuclei in the middle of the shell might have a certain "softness" or, alternatively, that effects of collective nature should be expected. New results were obtained on the even-even nuclei ^{48,50}Cr and ^{44}Ti, the odd-A nuclei ^{47}Ti and ^{47}V, and the odd-odd nucleus ^{48}V. This is one of the first systematic "in-beam" investigations by gamma spectroscopy with heavy ions in the $1f_{\frac{7}{2}}$ shell. It is concluded that heavy projectiles together with gamma coincidence techniques are a very powerful tool to investigate complicated spectra; in particular, this type of reaction is practically the only method to get information about the high-spin states that often have the most pure configurations. (13 figures) (RWR)

8438 SEMI-CLASSICAL VIEW OF HEAVY ION COLLISIONS. Landowne, S. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nukleonika; 19: No. 3, 157-181(1974).

These lectures are based upon a series of papers on which collaboration was done. In addition to the co-authors of these papers, the present work owes much to numerous discussions with theorists experimentalists at the Niels Bohr Institute who are collectively referred to as the Copenhagen Heavy Ion Workshop. Having made these acknowledgements, responsibility must be accepted for the shortcomings of the viewpoint developed here. It is simplified not only to fit my tastes but, I hope, to reach a wide audience. Heavy ion elastic scattering, inelastic scattering and transfer reactions are considered from a semi-classical point of view and will use the insight thus gained to draw some conclusions on the nature of the nuclear ion-ion interaction. (auth)

8439 NUCLEAR-STRUCTURE STUDIES ON THE $1f_{\frac{7}{2}}$–$2p_{\frac{3}{2}}$ SHELL BY PROTON RADIATIVE CAPTURE INVOLVING ISOBARIC ANALOG STATES. Fodor, I. (Central Research Inst. for Physics, Budapest). pp 129-158 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

Results of gamma spectroscopy achieved by using (p,γ) reactions are collected. The $p_{\frac{3}{2}}$, $p_{\frac{1}{2}}$, $f_{\frac{5}{2}}$, and $g_{\frac{9}{2}}$ analog resonances are discussed in several nuclei in the $1f_{\frac{7}{2}}$–$2p_{\frac{3}{2}}$ shell. Isobaric analogs of bound single-neutron states occur at a few (5–10) MeV of excitation energy, because of the large Coulomb energy displacements. Resonances with sufficiently large proton and not too small gamma partial widths, Γ_p and Γ_γ, can be observed in the (p,γ) excitation function (γ-yield curve as a function of the bombarding proton energy). Owing to their positive Q values, in the (p,γ) reactions the isobaric analogs can be reached with low-energy accelerators. Most of the investigations were made at Van de Graaff generators of 2–4 MeV. The excitation functions can be taken by NaI(Tl) crystals, while, after the identification of analog resonances, γ spectra can be measured with Ge(Li) semiconductor detectors. Spin and parity assignments of the resonances were obtained in more cases from angular distribution measurements. In the mass region investigated, the analog resonances decay mostly by $\Delta T = 1$, M1 transitions; therefore, the isovector part of the transition operator can be studied, or, by assuming hypothetical g factors, configurations of the initial and final states can be deduced. Thus so, one can obtain information, not only on the structure of analog states—as in (p,p) measurements—but even configurations of the final states can be determined. The structure of the so-called antianalog states is discussed. The results of the (p,γ) experiments are compared with those of proton transfer reactions as, e.g., (^{3}He,d). The following character-

istics of the analog states are discussed: $(2J+1)S_n$, spectroscopic strengths of the parent states measured in (d,p) stripping reactions; S_{pp}, the proton spectroscopic factors deduced from the measured Γ_p partial widths in proton elastic-scattering experiments, which can be compared with S_n; $(2J+1)C^2S$ spectroscopic strengths, found in (^{3}He,d) proton transfer reactions for the final states of the electromagnetic transitions; $\Gamma_\gamma(M1)_{\Delta T=1}$ gamma partial widths, together with branching ratios where they are available. Finally, an attempt is made to give a phenomenological explanation for the strong analog–antianalog M1 transition in the case of $g_{\frac{9}{2}}$ analog resonances found in several isotopes of copper. They have features very similar to the $f_{\frac{7}{2}}$ and $p_{\frac{3}{2}}$ resonances in s–d shell with $\Gamma_\gamma(M1)_{\Delta T=1} \sim 1$ Weisskopf unit. (14 figures, 9 tables) (auth)

8440 NUCLEAR LIFETIMES IN ^{42}Ar. Fisher, T.R.; Bardin, T.T.; Becker, J.A.; Watson, B.A. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). Phys. Rev. C 9: No. 2, 598-602 (Feb 1974).

Excitation energies and nuclear lifetimes of states in ^{42}Ar have been measured by employing the reaction ^{40}Ar(t, p)^{42}Ar at a triton bombarding energy of 2.8 MeV. Protons were detected by an annular silicon surface barrier counter at an average angle of 174 °, and coincident γ rays were detected by a 20-cm^3 Ge(Li) counter positioned at angles of 30 and 120 °. The extraction of nuclear lifetimes by the Doppler-shift-attenuation technique was made possible by the use of a solid argon target operated at 15 °K. Experimental results for excitation energies (keV) and lifetimes (psec) are: 1208.2 ± 0.3, $3.8^{+1.0}_{-0.8}$; 2486.7 ± 0.6, 0.40 ± 0.16; 2512.5 ± 0.5, $4.0^{+2.1}_{-1.3}$; 3014.6 ± 0.6, <0.12; 3096.4 ± 0.6, >5; 3557.8 ± 0.6, <0.09; 4006.1 ± 0.6, 3.3 ± 0.8; 4127.4 ± 0.7, 1.4 ± 0.3; 4287.0 ± 0.7, <0.05; 4633.7 ± 0.7, <0.05. The experimental results are in good agreement with the shell-model calculations of Gloeckner, Lawson, and Serduke. (auth)

8441 EXCITATION OF A GIANT ISOSCALAR RESONANCE BY α PARTICLES. Rutledge, L.L. Jr.; Hiebert, J.C. (Cyclotron Institute and Physics Department, Texas A & M University, College Station, Texas 77843). Phys. Rev. Lett. 32: No. 10, 551-554 (11 Mar 1974).

The inelastic scattering of 115-MeV α particles from ^{40}Ca shows an enhancement of the continuum at about 18.25 MeV excitation energy. This observation supports recent electron, proton, and ^{3}He scattering analyses which ascribe similar enhancements at $E_x \simeq 63/A^{1/3}$ MeV to an isoscalar giant quadrupole resonance. Although contributions from a monopole excitation cannot be ruled out, attributing all observed yields to a giant quadrupole resonance exhausts only 32% of the energy-weighted sum rule. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 8397, 8398, 8413, 8430, 8453, 8454, 8463, 8532, 8540, and 8544.

8442 (KFK-EXT-3-74-2) MEASUREMENT OF THE HALF-LIFE OF RECOIL NUCLEI AND THE ORIENTATION OF THEIR SPINS FOLLOWING THE BETA-DECAY OF ^{73}Se. Schwall, M. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Feb 1974. 94p. (In German). Dep. NTIS (US Sales Only) $7.75.

Thesis. Submitted to Univ., Karlsruhe, Ger.

Experiments using recoil nuclei arising from an allowed beta-decay are reported. As a radioactive source ^{73}Se was used. The half-life of the 428-keV level in the daughter nucleus was determined to $(5.0 \pm 0.6) \cdot 10^{-6}$ sec in full agreement with preceding measurements. This time is convenient for observation of recoil nuclei in flight. The spin orientation of recoil nuclei with respect to their direction of flight was determined for the first time whereby the anisotropy of the gamma radiation emitted by the recoil nuclei in flight was registered. Use was made of the counting rate difference between an essentially unperturbed angular correlation and a correlation totally disturbed by a suitable applied magnetic field. From the sign of the anisotropy the ground state spin of ^{73}Se was determined to $\frac{9}{2}$. This result is in contradiction to measurements employing conversion coefficients for the spin determination. Arguments are presented which may resolve the ambiguity. The size of the anisotropy is related to disturbance effects by the atomic electron shells. (auth)

8443 EMISSION OF THE LITHIUM NUCLEUS FORMED IN A PHOTOEMULSION BY π MESONS WITH 60 GeV ENERGY. Amankulova, D. S.; Morozova, P. V.; Takibaev, Zh. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 34-40(1973). (In Russian).

The formation of the Li nucleus in photoemulsions by 60-GeV π mesons on Ag and Br was studied. The principal characteristics of the process for the emission of the Li nucleus in the interaction with $N_h \geq 7$ and the energy and angular distributions were reported. The angular distributions of fine, medium, and black tracks in stars connected with the Li nucleus were obtained. The results were compared with the conclusions of the evaporation theory. (tr-auth)

8444 LIFETIMES FOR NUCLEAR ENERGY LEVELS IN COPPER AND THE SELF ABSORPTION TECHNIQUE. Groenewald, W. A. Stellenbosch, S. Afr.; Stellenbosch Univ. (1972). 121p. (In Afrikaans). Atomic Energy Board, Pretoria.

Thesis.

Recently nuclear resonance fluorescence measurements have been performed at the University of Stellenbosch to determine the continuum in the energy spectrum of a kilocurie ^{60}Co source. The results of the spectrum determinations of Visser (Vi 72) and Van der Merwe (Vd 72) for two different ^{60}Co sources are discussed. It is shown that these measurements throw doubt on the correctness of the available mean lifetimes for the 770, 962 and 1115 keV levels in the copper isotopes. The purpose of the project which is described was to obtain accurate values for the mean lifetimes of the above-mentioned levels by means of the self-absorption technique. Experimental details for the self-absorption measurements are given. The observation of resonance fluorescence by means of Compton-scattered gamma radiation is discussed and a description is given of the cobalt unit of the F.F.R.I. as well as the experimental arrangement used. Elastic scattering experiments were performed with a lead scatterer in the direct ^{60}Co-beam to investigate the constancy of the gamma-output from the source and its shielding during self-absorption measurements. Several calculations were performed to determine the most suitable thickness for the absorbers, and the scatterer used in the measurements. A discussion is given of the determination of the mean lifetimes of the above-mentioned copper levels. The matching of nonresonant absorbers with resonant absorbers, measurement procedures followed and calculations performed are discussed in detail. The mean lifetimes obtained in the measurements are: ^{65}Cu (0.770 MeV) : $\tau = 1.8 \pm 0.3 \times 10^{-12}$ s, ^{63}Cu (0.962 MeV) : $\tau = 8.8 \pm 1.0 \times 10^{-13}$ s, and ^{65}Cu (1.115 MeV) : $\tau = 2.5 \pm 0.3 \times 10^{-13}$ s. The results obtained are in good agreement with the lifetime measurements of Karsten (Ka 71) but differ from a number of other results. Except for possible errors in the known angular distribution of the resonantly scattered radiation for the copper levels, the present study gives no explanation for the extraordinary high values of the $N(E_\gamma)$ points for the copper levels in the gamma spectra of Visser and van der Merwe. However, doubt exists as to the suitability of the self-absorption technique as a method for determining accurate nuclear lifetimes with the present experimental set-up. (auth)

8445 FINE STRUCTURE OF DIFFRACTION ANGULAR DISTRIBUTIONS. Yushkov, A. V.; Pavlova, N. N. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 19: No. 4, 729-732(Apr 1974). (In Russian).

Fast oscillations with about 1.5° period are found in the angular distributions of the α particles inelastically scattered with excitation of the 2^+ level in the nucleus ^{68}Zn. The measurements are made at 29.0, 40.7 and 50.5 MeV for 4, 5, 6 and 7 oscillations of the Fraunhofer type. The found deviations from Blare phase rule are related to some peculiar features of the surface structure of the zinc nuclei. (auth)

8446 ISOTOPE EFFECTS IN TOTAL CROSS SECTIONS OF THE REACTIONS INDUCED BY DEUTERONS AND α PARTICLES. Bulkin, V. S.; Dubar, L. V.; Nemets, O. F.; Slyusarenko, L. I.; Tokarevskii, V. V. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 19: No. 4, 733-739(Apr 1974). (In Russian).

The isotope–isotone effect in total cross sections of the reactions induced by deuterons and α particles is investigated. The experimental total cross sections of the reactions induced by α particles are compared with the theoretical quantities, calculated in the diffractional approach. The deuteron total cross sections are compared with the theoretical ones calculated using the optical nuclear model. It is shown that diffusivity of the nuclear boundary increases in turning from a light isotope to a heavier one due to a variation of the neutron density in the boundary layer. (auth)

8447 DIPOLE STATES IN ^{86}Sr, ^{88}Sr, AND ^{90}Zr. Robertson, R. P. (Univ. of Melbourne, Parkville, Australia). Aust. J. Phys.; 27: No. 1, 21-30(Feb 1974).

A shell model method for calculating dipole states in N > Z even nuclei is discussed. By assuming isospin to be a good quantum number, the spectrum resolves into two classes of states differing in isospin. Applications of this model to ^{88}Sr and ^{90}Zr essentially differ from previous calculations by the use of a new real-

istic force in the residual interaction. Dipole states in ^{88}Sr are also investigated along with the effect of correlating the ground state wave function. (auth)

8448 RADIATIVE CAPTURE OF PROTONS BY MEDIUM-WEIGHT NUCLEI. Storizhko, V. E.; Nemashkalo, B. A. (Physical-Technical Inst., Kharkov). pp 121-128 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

A theoretical expression for the gamma–gamma triple angular correlation function $W(\Theta_1\ \phi_1;\ \Theta_2\ \phi_2)$, where the angles are with respect to the incident beam, was developed by using assumptions from the statistical theory of nuclear reactions for the case of proton capture in medium-weight nuclei. The analysis of measurements made with the electrostatic accelerator of the Kharkov Physico-Technical Institute for the nuclei ^{51}Mn, ^{52}Mn, ^{59}Mn, ^{61}Cu, ^{65}Ga, ^{67}Ga gives values for the spin and parity of the states resulting from the first photon transition C^{γ}, as well as values for the two most important mixing coefficients, δ_1 and δ_2, that are in good agreement with values obtained by other methods. This fact shows that the new method should provide reliable spectroscopic information even in cases where the particle-capture reaction does not yield narrow, isolated resonances. (2 figures, 1 table) (auth)

8449 TEMPERATURE-DEPENDENT ELECTRIC QUADRUPOLE INTERACTION OF ^{67}Zn IN ZINC METAL. Bertschat, H.; Recknagel, E.; Spellmeyer, B. (Bereich Kern- und Strahlenphysik, Hahn-Meitner-Institut für Kernforschung Berlin, Berlin-West, Germany, and Fachbereich Physik der Freien Universität, Berlin-West, Germany). Phys. Rev. Lett. 32: No. 1, 18-21 (7 Jan 1974).

By means of time-differential observation of perturbed angular distributions of γ radiation following the nuclear reaction ^{66}Zn(d, p), the electric quadrupole interaction frequency of the isomeric $9^+/2$ state of ^{67}Zn in zinc metal has been measured as a function of temperature. At room temperature the frequency was determined to be $e^2qQ/h = 45.5(4)$ MHz. The temperature dependence is compared with previous results for ^{111}Cd in cadmium. (auth)

8450 ABSOLUTE γ-RAY INTENSITIES IN THE DECAY OF ^{79}Kr AND ^{127}Xe. Collé, R.; Kishore, R. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 9: No. 3, 981-987 (Mar 1974).

Absolute γ-ray intensities in the decay of ^{79}Kr and ^{127}Xe have been determined from sources which were produced by (p, n) reactions on encapsulated potassium–halide targets. Absolute γ-ray emission rates of these sources were first measured with several calibrated Ge(Li)-detector systems. Then, following separation of the ^{79}Kr or ^{127}Xe gas, absolute disintegration rates of the sources were obtained by counting internally in gas proportional counters. Comparisons of the present results with previous work are made and although there are no major discrepancies, several inconsistencies in the existing decay schemes are resolved and the uncertainties in the absolute γ-ray intensities are substantially reduced. The half-lives for ^{79}Kr and ^{127}Xe were measured by both gas proportional counting and γ-ray spectrometry and are 35.04 ± 0.10 h and 36.3 ± 0.3 day, respectively. (auth)

8451 EVIDENCE FOR COEXISTENCE OF SPHERICAL AND DEFORMED SHAPES IN ^{72}Se. Hamilton, J.H.; Ramayya, A.V.; Pinkston, W.T.; Ronningen, R.M.; Garcia-Bermudez, G.; Carter, H.K. (Physics Department, Vanderbilt University, Nashville, Tennessee 37235); Robinson, R.L.; Kim, H.J.; Sayer, R.O. Phys. Rev. Lett. 32: No. 5, 239-243 (4 Feb 1974).

We report evidence for an excited $K^{\pi} = 0^+$ rotational band in ^{72}Se and its mixing with vibrational states. The mean life of the 937-keV $0^{+\prime}$ state was measured to be 22.8 ± 1.4 nsec, yielding $B(E2) = 36 \pm 7$ single-particle units for the 75-keV $0^{+\prime} \rightarrow 2^+$ transition. From in-beam, γ-ray spectroscopy following the reaction ^{58}Ni(^{16}O, 2p), a strong γ-ray cascade was observed from an yrast band of levels 0^+, 2^+, ... to spin 12^+ in ^{72}Se. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 6628, 6724, 8380, 8397, 8417, 8429, 8431, 8443, 8447, 8450, 8499, 8511, 8532, and 8544.

8452 (CEA-R-4563) DECAY OF ^{144}La($T_{\frac{1}{2}}$ = 41 SEC). Monnand, E.; Brissot, R.; Carraz, L. C.; Schussler, F.; Moussa, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). Apr 1974. 18p. (In French). Dep. NTIS (US Sales Only) $4.00.

A study of the decay of ^{144}La was made. The activity is produced by rapid chemical separation from fission products or on-line with the ARIEL isotope separator. The half-life is 41.0 ± 1.0 sec. The Q_β is 4.6 ± 0.2 MeV. The energy and relative intensity of the most intense γ rays were measured. The three first excited levels of ^{144}Ce are deduced from the results of coincidence measurements. (auth)

8453 (UCRL-50400(Vol. 7)(Pt. A)) GRAPHICAL, EXPERIMENTAL DATA FOR MAJOR NEUTRON-INDUCED INTERACTIONS ($Z \leq 55$). Cullen, D. E.; Haight, R. C.; Howerton, R. J.; MacGregor, M. H.; Perkins, S. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1974. Contract W-7405-eng-48. 718p. Dep. NTIS $13.60.

The total, elastic, capture, and fission cross sections contained in the Experimental Cross Section Information Library (ECSIL) as of March 1, 1974 are presented in graphical form. For the sake of clarity, these data are plotted without associated error bars. The plots are arranged in ascending order of atomic number (Z) and atomic weight (A). Part A contains the plots for Z = 1 to 55, and Part B contains the plots for $Z > 55$. (auth)

8454 SHELL AND UNIFIED NUCLEAR MODEL CALCULATIONS. Shell Model Calculations With a Surface Delta Effective Interaction on Light Nuclei With $10 \leq A \leq 15$ and Unified Model Calculations in Weak and Intermediate Coupling on Non-Deformed Odd-A Nuclei: ^{45}Sc, ^{75}As, and ^{93}Nb. Saaymen, R. Stellenbosch, S. Afr.; Stellenbosch Univ. (1972). 237p. Atomic Energy Board, Pretoria.

Thesis.

Nuclear model calculations are hampered by two major problems: the nucleus as many-body system of interacting particles has no exact solution, and little is known about the forces that keep the protons and neutrons together. An approximated solution to the nuclear problem is embodied in the shell model, which was presently applied in an investigation of light nuclei in the mass region $10 \leq A \leq 15$, as described. A theoretical outline is provided for treating a many-nucleon system in terms of effective two-body interactions, which are chosen to have zero range and take place at the nuclear surface only. The results of numerical calculations performed on natural parity states in nuclei with $10 \leq A \leq 14$ are given. As basis of this description an inert ^{4}He core is assumed with the two-body interactions of the outer (A-4) nucleons in the $1p_{\frac{3}{2}}$ and $1p_{\frac{1}{2}}$ subshells. This model is extended to account for both negative and positive parity states in the mass-15 isobars. The inert core is recomposed from ^{4}He to ^{12}C, and the configuration space is systematically expanded to allow for an increasing number of particle excitations from the 1p into the 2s-1d shell. Odd-A nuclei of local experimental interest are treated as coupled systems consisting of a collective even–even core plus the odd particle moving in shell orbitals outside the core. The formalism underlying such a description is presented. The weak coupling version is used to account for excited-core multiplets of negative parity in some 1f-2p nuclei, in particular ^{45}Sc and ^{75}As. The intermediate coupling version is applied to test spin-parity assignments for low-lying positive parity levels of ^{93}Nb. The calculations reported have the following common basis: they all involve configuration mixing and consequently require the diagonalization of energy matrices. In each case adjustable model parameters viz single-particle energies and interaction strengths, are determined from the requirement that the eigenvalues be a good fit to measured level energies in the nuclei under consideration. Apart from calculated energy spectra, wave functions are also extracted, which are then used to calculate other observable properties of nuclei e.g. spectroscopic factors, electromagnetic multipole moments and transitions. (auth)

8455 NUCLEAR DATA SHEETS FOR A = 145. Burrows, T. W. (Univ. of Kentucky, Lexington). Nucl. Data Sheets; 12: No. 2, 203-243(Jun 1974).

The 1967 version of the Nuclear Data Sheets for A = 145 was revised on the basis of experimental data received by May 31, 1973. Pertinent data received between May 31 and November 30, 1973, were added in proof. The A = 145 chain consists of 11 nuclei (Xe through Gd). Four of these nuclei (Xe through La) have been assigned since 1968. While some γ-rays have been associated with the decay of these four nuclei, the associations are not definite enough to construct decay schemes. The decay schemes of ^{145}Ce, ^{145}Pr, ^{145}Pm, and ^{145}Sm are essentially unchanged from the 1967 compilation. By combining decay data with recent capture-gamma, Moessbauer, and stripping-reaction data, the compilers were able to assign 4 definite and 13 probable J^{π} values to the ^{145}Nd level scheme. Seven definite and 8 probable J^{π} values have been assigned to the ^{145}Sm level scheme on the basis of electron-capture-decay, atomic-beam, and stripping-reaction data; however, there are still problems associated with this

scheme. The lack of conversion-electron studies on the decay of ^{145}Gd has greatly hindered the assignments of definite spins to levels in ^{145}Eu. Several discrepancies and problems are pointed out in the Comments. (auth)

8456 NUCLEAR DATA SHEETS FOR A = 139. Greenwood, L. R. (Northwestern Univ., Evanston, IL). Nucl. Data Sheets; 12: No. 2, 139-202(Jun 1974).

The 1966 version of the Nuclear Data Sheets was revised according to experimental data received prior to January 1974, including approximately 150 papers. Data are presented for 11 nuclei (I, Xe, Cs, Ba, La, Ce, Pr, Nd, Pm, Sm, and Eu). No decay schemes are available for the ground-state decay of I, Pm, Sm, or Eu, and no excited states or gamma transitions have been definitely assigned to I, Xe, Pm, or Eu. The Xe and Cs decay schemes have been extensively studied; however, no J^π assignments are available for the 50 excited states of Cs because of the lack of gamma multipolarity assignments and no J^π assignment for the Xe ground state. The Ba level scheme includes about 100 levels with about 43 J^π assignments because of the extensive Cs decay, (n,γ), and (d,p) data. The La level scheme includes about 80 levels with about 27 J^π assignments. More detailed J^π assignments cannot be made, primarily because of the lack of gamma multipolarity data or definitive l values in reaction data. About 28 levels have been assigned to Ce with only 17 J^π assignments, again primarily because of the lack of gamma multipolarities. Pr has been assigned 30 levels with 24 J^π values. Rather extensive gamma multipolarities (35) are assigned in Pr. Only 6 levels have been placed in Nd, with J^π assignments for only the ground state (29.7 m) and isomer (5.5 h), the other four levels being due to (α,xnγ) data. Four levels are suggested in Sm from the 9.5-s isomer internal gamma decay to the ground state (2.6 m), although no J^π values are known since no gamma multipolarities are known and no decay scheme is available for the ground state. (auth)

8457 PROMOTION OF HEAVY ION SCIENCE. Heavy Ion Science Research Committee Report (1971, 1972 Fiscal Years). Husimi, K. Nippon Genshiryoku Gakkaishi; 16: No. 1, 30-33 (Jan 1974). (In Japanese).

The heavy ion science research committee has worked on the promotion of heavy ion science, which consist of various fields on nuclear physics, solid state physics, nuclear chemistry, radiation chemistry and biology, during 1971 and '72 fiscal years. This is a report of its activity, and the necessity and the method of the promotion are proposed. (auth)

8458 MECHANISM FOR THE EXCITATION OF ISOBARIC ANALOG STATES FROM AN ANALYSIS OF THE CROSS SECTION FOR THE (p,n) REACTION AND (p,p_0) ELASTIC SCATTERING OF PROTONS. Zvenigorodskii, A. G.; Guzhovskii, B. Ya.; Abramovich, S. N.; Trusillo, S. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2641-2643(Dec 1973). (In Russian).

Isobaric analog resonances of the isotopes ^{104,106,108,110}Pd, were observed in (p,n) reactions and proton elastic scattering. The absolute (p,n) cross section at 170° from 6.4 to 7.2 MeV and the scattering cross section relative to that for Coulomb scattering from 6.5 to 7.2 MeV at angles 50° to 170° are shown for ^{108}Pd. Widths for the first two resonance states in each isotope are tabulated. (RWR)

8459 PROCEEDINGS OF THE SYMPOSIUM ON IN-BEAM SPECTROSCOPY WITH HEAVY IONS, WAKO, JAPAN, SEPTEMBER 1-2, 1972. Kamitsubo, H.; Nomura, T. (eds.). IPCR Cyclotron Progress Report, Supplement 2. Wako, Japan; Institute of Physical and Chemical Research (1973). 144p. (CONF-7209112-).

Separate abstracts were prepared for each of the 11 papers in this report. (RWR)

For abstracts of individual papers see: 8399, 8427, 8437, 8460–8463, 8484, and 8528–8530.

8460 COULOMB EXCITATION WITH HEAVY IONS. Greenberg, J. S. (Yale Univ., New Haven). pp 23-46 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

Coulomb excitation with projectiles heavier than electrons is discussed. In any multiple excitation process such as Coulomb excitation, the matrix elements must be established in a step-by-step procedure, which for Coulomb excitation involves the use of a succession of projectiles of progressively higher mass. It is important to note that the matrix elements associated with the ground state play a decisive role in the multiple excitation analysis, and they must be determined independently if there is to be any hope of accomplishing a model-independent analysis of the heavy-ion data. The discussion of multiple Coulomb excitation includes some of the difficulties associated with the method and an attempt to keep these in perspective. The topics considered are static quadrupole moments of excited states, electric hexadecapole transition moments, and higher-order multiple excitation. Data on ^{114}Cd, ^{153}Sm, and ^{154}Sm are given. (25 figures) (RWR)

8461 M2 AND E3 TRANSITIONS BETWEEN SINGLE QUASI-PROTON STATES IN MEDIUM NUCLEI. Ejiri, H. (Osaka Univ., Toyonaka, Japan). pp 90-100 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

Gamma rays from (α, 2n) reactions on medium nuclei with N ≈ 82 were studied. Reduced matrix elements B(M2) and B(E3) were obtained for the single quasi-proton transitions 1h $1\frac{1}{2}$ → 1g $\frac{1}{2}$ and 1h $1\frac{1}{2}$ → 2d $\frac{1}{2}$. Detailed analysis of the M2 and E3 transitions in nuclei with N = 82 gave effective coupling constants $g^{eff}(M2)/g(M2) \approx 0.22$ and $g^{eff}(E3)/g(E3) \approx 3$. They were analyzed in terms of the spin–isospin core polarization (out of phase) and the octupole core polarization (in phase). (11 figures, 2 tables) (auth)

8462 LOW-LYING STATES IN ^{95}Tc STUDIED BY ^{93}Nb(α,2nγ) ^{95}Tc REACTION. Shibata, T.; Itahashi, T.; Wakatsuki, T. (Osaka Univ.). pp 101-106 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

Alpha particles with energies from 22 to 24 MeV were used to bombard a 4-mg/cm^2 metallic Nb foil. Gamma-ray spectra, angular distributions, and excitation functions were measured. A level scheme was constructed from γ–γ coincidence measurements. Levels having spins from $\frac{1}{2}$ to $13/2$ were found in the low-excitation region of ^{95}Tc. These states may have been formed by coupling the $1g_{\frac{9}{2}}$ proton to the E2 phonon. (5 figures) (RWR)

8463 PARTICLE AND HOLE SYMMETRY IN NUCLEAR COLLECTIVE EXCITATION OF MEDIUM NUCLEI WITH Z ≈ 50. Sakai, M. (Tokyo Univ.). pp 114-126 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

Neutron-rich isotopes with 40 ≤ Z ≤ 48 and neutron-deficient isotopes with 52 ≤ Z ≤ 60, treated independently as new quasi-deformed regions, were demonstrated to have an intimate relationship. Proton particle orbitals outside and the proton hole orbitals inside of the 50-proton closed shell couple with the neutron core in a symmetrical way to produce a very similar exicted level system in the pair isotones with 50 ± z. A simple theoretical consideration shows that it results from the special situation for these nuclear regions where the particle and hole orbitals involved in the nuclear excitation are $g_{\frac{9}{2}}$ and $g_{\frac{7}{2}}$, respectively, that is, $j_p \sim j_h$. This effect was also investigated for the nuclear regions near Z = 82 and 28. It was revealed that it holds nicely in the region near Z = 28, while a strong violation exists in the region near Z = 82. In connection with the discussion of the former region a nuclear structure study of ^{60}Fe with in-beam spectroscopy using the ^{48}Ca(^{18}O,α2n) reaction was reported. (16 figures) (auth)

8464 GENERAL FEATURES OF NUCLEAR HIGH SPIN STATES. Krumlinde, J. (Lund Inst. of Tech., Sweden). Nukleonika; 19: No. 3, 251-266(1974).

Some general features of high spin states in nuclei are discussed. A simple model is introduced and discussed qualitatively. (auth)

8465 NUCLEON CAPTURE IN NUCLEI WITH A > 100. Decowski, P. (Univ. of Warsaw). pp 235-248 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

The mechanism of low-energy nucleon capture is first discussed. It is shown that the statistical model of nuclear reactions successfully describes the measured excitation curves in the energy region below 10 MeV when all improvements of the model are taken into account. Then the eventual application of the Hauser–Feshbach formalism to determine the spins of the states reached by primary gamma-rays emitted from capture states is considered. The fact that in heavy nuclei a nucleon is captured into many overlapping compound states and gamma intensities are averaged over a beam energy spread much larger than the average distance between them is of great importance. Furthermore, the difficulties

to be encountered in such an approach are discussed. One of them is the experimental evidence of the gross structure in the capture gamma spectra in some nuclei which appears as the so-called "pygmy resonance." Hypotheses which can explain the nature of this resonance on the basis of doorway states are considered. There is a great lack of experimental information connected with these phenomena, especially in reactions induced by charged particles. Finally, a short discussion of the capture mechanisms at higher incident energies is presented. (14 figures, 1 table) (auth)

8466 HINDRANCE EFFECTS ON THE β MOMENTS FOR THE $(7/2)^-(0.435\text{-MeV }\beta^-)(7/2)^+$ TRANSITION FROM THE DECAY OF ^{141}Ce. Szybisz, L. (Institut für Experimentelle Kernphysik des Kernforschungszentrums, Karlsruhe, West Germany); Krmpotić, F.; Fariolli, M.A. Phys. Rev. C 9: No. 2, 624-631 (Feb 1974).

The β moments of the $(7/2)^-(\beta^-)(7/2)^+$ transition from the decay of ^{141}Ce have been extracted from the available experimental data. We have obtained the following results (expressed in fm): $\langle i\vec{\sigma}\cdot\hat{r}\rangle = 0.32 \pm 0.08$, $\langle i\vec{r}\rangle = 0.029 \pm 0.012$, $\langle\vec{\sigma}\times\hat{r}\rangle = -0.20 \pm 0.07$, $(B_\beta) = -0.43 \pm 0.57$, $\langle\gamma_5\rangle/\xi = 0.98 \pm 0.10$, and $\langle\vec{d}\rangle/\xi = 0.065 \pm 0.027$. These results show that the β-moments ratio A $(= \langle\vec{d}\rangle/\xi\langle i\vec{r}\rangle)$ agrees with the theoretical estimation of Fujita–Eichler $A = 2.36$, and that the β moments are strongly reduced with respect to a conventional pairing model. In addition, the value of the spin-flip γ moment $\langle 1g_{(7/2)}||\vec{r}||2f_{(7/2)}\rangle_\gamma$, measured in the (e, ep) reaction through the isobaric-analog state in ^{139}La, is inconsistent with the present analysis. (auth)

8467 MEASUREMENTS OF DIRECTIONAL CORRELATION FROM ORIENTED NUCLEI (DCO) AND THE BAND STRUCTURE IN ^{102}Pd. Grau, J.A.; Grabowski, Z.W.; Rickey, F.A.; Simms, P.C.; Steffen, R.M. (Tandem Accelerator Laboratory, Purdue University, Lafayette, Indiana 47907). Phys. Rev. Lett. 32: No. 12, 677-680 (25 Mar 1974).

A new technique for determining spin sequences and mixing ratios has been used to investigate the ground state band of ^{102}Pd. This new method is based on the observation of coincidences at only one angle rather than measuring a complete angular correlation. The results show that the unusual spin sequence previously proposed for the ground state band of ^{102}Pd is not correct. (auth)

8468 SEARCH FOR CLOSED-SHELL EFFECTS ON THE E2/M1 MIXING OF TRANSITIONS IN ^{116}Sn. Garcia-Bermudez, G.; Gupta, S.L.; Singhal, N.C.; Ramayya, A.V.; Lange, J.; Hamilton, J.H. (Physics Department, Vanderbilt University, Nashville, Tennessee 37235); Johnson, N.R. Phys. Rev. C 9: No. 3, 1060-1063 (Mar 1974).

Directional-correlation measurements of several cascades in ^{116}Sn have been made with a NaI–Ge(Li) detector system. Of particular interest is the 819-keV, $2^{+\prime}\rightarrow 2^+$ transition which was classified earlier as 90% E2 and almost pure M1 by two different groups. The γ-γ (θ) measurements of the $2^{+\prime}$(819-keV)$\rightarrow 2^+$ (1293-keV)$\rightarrow 0^+$ cascade yield A_2 and A_4 coefficients of 0.31(2) and 0.27(5), respectively. From these data a δ (E2/M1) of −1.8(2) is obtained for the 819-keV transition, which corresponds to 76.4 ± 3.7% E2 radiation. The γ-ray intensities were measured more precisely.

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 7961, 8152, 8460, 8464, 8495, 8496, 8511, 8530, 8532, and 8544.

8469 (JINR–E4-7818) ROTATION EFFECT ON THE LEVEL DENSITY OF DEFORMED NUCLEI. Malov, L. A.; Soloviev, V. G.; Voronov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The effect of the rotational motion on the density of the highly excited states of deformed nuclei is studied. It is shown that the account of the rotational motion makes the description of the density of states with high spins essentially better. The spin dependence of the density at energies higher than 4 MeV is found to be close to the dependence obtained by the statistical model. It is shown that the semi-microscopic approach taking into account the vibrational and rotational motions gives a good description of the excited state density for deformed nuclei at the neutron binding energy B_n. (auth)

8470 PRECISION DETERMINATION OF SOME γ-RAY ENERGIES USING THE FRIBOURG CURVED-CRYSTAL SPECTROMETER. Beer, W.; Kern, J. (Univ. of Fribourg, Switzerland). Nucl. Instrum. Methods; 117: No. 1, 183-187(1974).

The energies of several γ rays from the decay of ^{169}Yb, ^{170}Tm, and ^{192}Ir were determined with the Fribourg curved-crystal spectrometer, using a 4-mm-thick [110] quartz plate. The most intense lines were observed with reflection orders up to n = 10 and 12; relative precisions down to a few ppm were thus obtained. The spectrometer was calibrated with the (411.794 ± 0.007) keV γ-ray transition in the decay of ^{198}Au. (5 tables) (auth)

8471 NEUTRON SELF-SHIELDING FACTORS FOR TANTALUM IN THE ENERGY RANGE OF 45 eV TO 50 keV. Krinninger, H. (INB, Bensber, Ger.); Ruppert, E.; Hintze, L. Nucl. Instrum. Methods; 117: No. 1, 45-60(1974).

The neutron capture cross sections for tantalum of technical quality were measured with the aid of a lead spectrometer in the energy range of 45 eV to approx 50 keV. Furthermore, the self-shielding factors as a function of the energy and the surface coverage were determined by using tantalum foils of various thicknesses. (12 figures, 5 tables) (auth)

8472 SOME RETARDED MAGNETIC DIPOLE TRANSITIONS IN ^{153}Gd. Sabota, H. S. (Punjabi Univ., Patiala, India). Indian J. Phys.; 47: No. 11, 660-664(Nov 1973).

Penetration effects were established for the first time in the 109 and 129 keV predominantly M1 and highly hindered transitions in ^{153}Gd. The K and L subshell electron intensity analysis in conjunction with the respective theoretical conversion coefficients yields the penetration coefficients $\lambda = -10.5^{+1}_{-1}\frac{1}{2}$ and $\lambda = -24^{+1}_{-1}\frac{1}{2}$ for the 109 and 129 keV transitions respectively. From the fact that the internal conversion process of the 87 keV transition from the 129 keV level was found to be normal, whereas that of 129 keV transition is penetration affected the spin of the 129 keV level, so that this latter transition is 1-forbidden is suggested to be 52^-. (auth)

8473 STUDY OF THE ANGULAR DISTRIBUTIONS OF PROTONS FROM THE REACTION ^{162}Dy(d,p)^{163}Dy AT 12.1 MeV. Holan, P. (Charles Univ., Prague); Rozkos, M.; Sterba, F.; Cejpek, J. Czech. J. Phys.; 24: No. 4, 395-412(1974).

The angular distributions of protons from the reaction ^{162}Dy (d,p)^{163}Dy were measured. The experimental results were analyzed in a distorted waves Born approximation theory and the transferred angular momentum and spectroscopic factors were determined for the stronger transitions. The experimental spectroscopic factors were compared with the Nilsson model including the pairing effect. (auth)

8474 CORRELATION BETWEEN THE REDUCED NEUTRON AND PARTIAL RADIATIVE WIDTH IN THE REACTION ^{155}Ge(n,γ). Efimov, B. V.; Sokolovskii, L. L. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 19: No. 4, 712-714(Apr 1974). (In Russian).

The Ge(Li) spectrometer is used to measure the spectrum from the reaction ^{155}Gd(n,γ). The contributions from various resonances are made equal by means of the Gd filter. The J^π values of the final states determined from the averaged intensities of the 22γ-transitions agree with the available data. It is shown that in the presence of the Gd filter the spread of the normalized intensities of γ-transitions is decreased by 20% and the evidence appears for the possible effect of the correlation between the reduced neutron and partial radiative widths for two γ-transitions to the rotational band. (auth)

8475 NUCLEAR DATA SHEETS FOR A = 158. Tuli, J. K. (Indiana Univ., Bloomington). Nucl. Data Sheets; 12: No. 2, 245-304(Jun 1974).

Experimental nuclear data for nuclides with mass 158 are presented. All nuclei with Z between 62 and 72 with the exception of Lu(Z = 71) have been reported for this mass number. Although gammas in ^{158}Eu ground-state decay have recently been studied with better accuracy, there is uncertainty regarding β feeding of ^{158}Gd levels. The study of ^{157}Gd(n,γ) reaction with a crystal diffraction spectrometer has enabled the determination of ^{158}Gd levels with greater precision. However, there remain a large number of unassigned gamma transitions seen in (n,γ) reaction; also, the conversion electron data from n-capture studies could not easily be correlated with other available data on ^{158}Gd. There is ambiguity regarding the Q^+ value in (ϵ/β^+) decay of ^{158}Ho. It is also not clear which of the gammas seen in ^{158}Ho decay are due to the direct feeding of ^{158}Dy levels by the 27-m ^{158m}Ho state. Unless indicated otherwise, all energies given are in MeV. Every effort was made to include all data available prior to July 1, 1973. Some of the older data were omitted or referenced under "other measurements." (auth)

8476 PARITY DETERMINATION OF HIGH SPIN YRAST LEVELS IN ^{156}Er. Gono, Y.; Zolnowski, D. R.; Heanni, D. R.; Sugihara, T. T. (Texas A and M Univ., College Station). Phys. Lett.; 49B: No. 4, 338-340(29 Apr 1974).

Spectra of internal-conversion electrons from the ^{148}Sm(^{12}C,4n) ^{156}Er reaction have been used to show that an unusual odd-spin

band in ^{164}Er, through which the yrast cascade proceeds at high spin, has negative parity. (auth)

8477 NUCLEAR STRUCTURE EFFECT IN THE INTERNAL CONVERSION OF THE 103 keV TRANSITION IN ^{153}Eu. Ramania, K. V.; Reddy, T. S.; Reddy, K. V. (Andhra Univ., Vizagapatam, India). Indian J. Phys.; 47: No. 10, 635-637(Oct 1973).

Previous work on this transition has suggested that there is a correlation with the so-called nuclear structure effects. In this paper a search for these effects was made by using more realistic theoretical calculations for internal conversion coefficients and penetration functions. The nuclear structure parameter λ is plotted vs the percentage E2 admixture δ^2. The values $\lambda = 7.65^{+}_{-}{}^{.}{}^{.}$ and $\delta^2 = 0.012^{+}_{-}{}^{.}{}^{.}{}^{.}{}^{.}$ were obtained. This result shows that the penetration matrix element is about seven times as large as the gamma-ray matrix element; this high value of λ indicates the influence of nuclear structure on the conversion coefficients of the 103-keV transition. (1 figure) (RWR)

8478 DECOUPLING IN THE POSITIVE PARITY BANDS IN ODD-MASS Er ISOTOPES. Kammuri, T. (Osaka Univ.). Phys. Lett.; 49B: No. 4, 332-334(29 Apr 1974).

Coriolis coupling calculations are performed on the positive parity rotational bands in odd-mass Er isotopes. Complete decoupling between extra particle and the core occurs at high spins. The fitted values of the inertial parameters are larger than those of the adjacent even-mass Er isotopes and have different dependence on the core angular momenta. (auth)

8479 ALGEBRAIC TREATMENT OF THE NUCLEAR QUADRUPOLE DEGREE OF FREEDOM. Janssen, D. (Joint Inst. for Nuclear Research, Dubna, USSR); Jolos, R. V.; Doenaue, F. Nucl. Phys.; A224: No. 1, 93-115(1974).

The collective quadrupole degree of freedom is described by a SU(6) algebra, generated by five generalized coordinates and conjugated momenta and their commutators. On this basis a collective Hamiltonian is derived where the parameters of the realistic nuclear Hamiltonian (single particle energies, matrix elements of the interaction) appear in terms of a few constants. The algebraic properties of the collective variables lead to a new quantum number N which restricts the maximal number of phonons contained in the collective states. The collective Hamiltonian is applied to the transitional nuclei ^{152}Gd and ^{150,152}Sm. The transformation into the intrinsic frame of reference yields explicit formulas for the potential energy, the mass coefficients and the moments of inertia in terms of the intrinsic deformation parameters. (auth)

8480 BACKBENDING IN ODD-A Ho ISOTOPES. Grosse, E.; Stephens, F.S.; Diamond, R.M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 32: No. 2, 74-77 (14 Jan 1974).

We have shown that backbending can occur in rotational bands of odd-A nuclei. The I versus ω^2 plots for the lowest $h_{11/2}$ band in ^{157,159,161}Ho are rather similar to the ones for the adjacent even-even nuclei. This is interpreted to mean that the $h_{11/2}$ proton is not strongly involved in the mechanism producing the backbending in this region. (auth)

8481 SHAPE COEXISTENCE AND ITS CAUSE IN ^{151}Gd. Kleinheinz, P.; Sheline, R.K. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 and Department of Physics, Florida State University, Tallahassee, Florida 32306); Maier, M.R.; Diamond, R.M.; Stephens, F.S. Phys. Rev. Lett. 32: No. 2, 68-71 (14 Jan 1974).

The (α, 3nγ) reaction has been used to study the level structure of ^{151}Gd. Energy spacings and other information indicate a small deformation for the observed $i_{13/2}$ decoupled band; whereas, a large prolate deformation is indicated by the normal rotational band associated with $h_{11/2}$ hole excitation. A simple explanation for these two shapes in ^{151}Gd is given, based on the Nilsson diagram, and the behavior is shown to be related to the well-known shape change occurring between 88 and 90 neutrons. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 8380, 8404, 8465, 8470, 8490, 8495, 8496, 8532, 8544, and 8555.

8482 (JU-RR-73-13) 6.1 S ISOMER AND ROTATIONAL BANDS IN ^{192}Os. Pakkanen, A.; Heikkinen, D. W. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Jul 1973. 26p. INIS.

A 6.1 ± 2 s activity was observed when natural Os targets were bombarded with 14.5-MeV neutrons. This activity was assigned to the decay of a high spin isomer in ^{192}Os at 2015.4 keV which is depopulated by M2 and E3 transitions. Singles and concidence γ-ray spectra have allowed the identification of seven new states in ^{192}Os. Several of these levels were placed in either the ground state or γ-vibrational bands, which are strongly mixed. Excitation energies and B(E2) ratios for these bands are compared with different theoretical models. (auth)

8483 FISSION BARRIER OF ^{209}Bi MEASURED BY ELECTRON INDUCED FISSION. Tuerck, D.; Ziga, W.; Clerc, H. G. (Technische Hochschule, Darmstadt, Ger.). Phys. Lett.; 49B: No. 4, 335-337(29 Apr 1974).

For ^{209}Bi an electrofission cross section below 10^{-36} cm^2 was measured by the observation of correlated binary fission tracks in mica detectors. From the cross-section data between 28 and 41 MeV electron energy, a fission barrier of 25.5 ± 1.5 MeV was deduced. The method offers the possibility to measure fission barriers at low angular momentum and for nuclei not accessible otherwise. (auth)

8484 IN-BEAM ALPHA SPECTROSCOPY OF N = 128 ISOTONES. Nomura, T. (Inst. of Physical and Chemical Research, Wako, Japan). pp 127-139 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan, Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

A new, simple pulsed-beam method of measuring alpha decay in the nanosecond range is described. Time distributions of alpha decays are taken between natural beam bursts of a cyclotron. Schematic diagrams of the electronics and experimental set-up are shown, along with typical spectra. Previously unknown N = 128 isotones were produced in the ^{208}Pb (^{12}C,4n)^{216}Ra, ^{208}Pb (^{14}N,5n) ^{217}Ac, and ^{209}Bi(^{14}N,5n)^{218}Th reactions at 6½ MeV/nucleon; delayed alpha spectra and excitation functions are given. Important features and possibilities of the present experimental method as a new spectroscopic tool are discussed. (12 figures) (RWR)

8485 A-PRIORI PRE-EQUILIBRIUM DECAY MODELS. Blann, M. (Univ. of Rochester, NY). Nukleonika; 19: No. 3, 183-201(1974).

Intranuclear transition rates for a-priori calculation of pre-equilibrium decay were calculated using both the imaginary optical potential and a nucleon–nucleon scattering approach which is improved over earlier results used in the geometry dependent hybrid model. Results of spectra calculated using these intranuclear transition rates in several formulations of the hybrid model are compared with each other and with experimental results for the reactions ^{209}Bi (p,p′) and ^{54}Fe (p,p′) at 39 and 62 MeV incident proton energy. Results calculated in several ways are found to be in reasonable agreement with data in view of the uncertainties of the calculation. It is shown that the initial target-projectile interaction may be treated as a direct reaction term for which it is essential to consider the geometry of the reaction with respect to the nuclear density distribution but, based on estimated nucleon mean free paths, higher order preequilibrium terms may be treated in a nonlocalized fashion. It is also shown that the relative lifetime dependence assumed in many exciton model calculations are in reasonable agreement with results from nucleon–nucleon scattering calculations at excitation energies below 25 MeV, but get progressively poorer at higher excitations. (auth)

8486 CROSS SECTION AND ANGULAR DISTRIBUTION OF PRODUCTS IN "QUASIFISSION" REACTIONS INDUCED BY 525-MeV ^{84}Kr IONS ON A ^{209}Bi TARGET. Hanappe, F.; Lefort, M.; Ngô, C.; Péter, J.; Tamain, B. (Chimie Nucléaire, Institut de Physique Nucléaire, 91406 Orsay, France). Phys. Rev. Lett. 32: No. 13, 738-741 (1 Apr 1974).

We observed "quasifission" events (or "incomplete fusion" events) in the bombardment of ^{209}Bi by 525-MeV ^{84}Kr ions. By a simple method, the angular distribution of these events has been obtained. Its maximum value appears around 65° lab, i.e., ~95° c.m. The integrated cross section for this reaction is 500 mb, more than 1/2 of the total reaction cross section. No symmetric fission coming from a complete fusion nucleus has been observed, and it seems that the "quasifission" reaction occurs instead of complete fusion, as was previously observed at 500 MeV bombarding energy. (auth)

8487 S- AND P-WAVE NEUTRON SPECTROSCOPY, PART Xd: INTERMEDIATE STRUCTURE, PARTICLE-VIBRATION STATES. Divadeenam, M. (North Carolina Central University and Triangle Universities Nuclear Laboratory, Durham, N. C. 27706); Beres, W.P.; Newson, H.W. Ann. Phys. (N.Y.) 80: No. 2, 231-241 (Oct 1973).

The weak coupling particle-vibration model is extended to lowlying neutron resonances in certain even-even or odd-odd nuclei by coupling the extra particle to core excited states of the odd mass target. The odd hole or particle in the target is treated as a passive spectator. ^{208}Pb and ^{210}Bi are studied as test cases and the calculated resonance quantities are in good agreement with the average features of high-resolution

experiments. The resonances in ^{208}Pb and ^{210}Bi are related to the same intrinsic doorway in ^{209}Pb. The ^{210}Bi data are presented here for the first time. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 7961, 8397, 8469, and 8544.

8488 (AECL-4704) STATUS OF FISSION PRODUCT YIELD DATA FOR THERMAL REACTORS. Walker, W. H. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Feb 1974. 84p. Dep. NTIS (US Sales Only) $7.25. AECL $2.00.

Methods of measuring fission product yields are discussed. Measured and evaluated chain yields from thermal neutron fission of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu are reviewed, and evaluated yields are compared. Measured fractional and direct yields of interest in reactor calculations are discussed and compiled. The few data on cumulative yields from fission by low-energy epithermal neutrons are noted, and their significance in reactor calculations is estimated. (auth)

8489 (EURFNR-1122) NEUTRON SPECTRUM MEASUREMENTS IN A DEPLETED URANIUM METAL BLOCK FOR INVESTIGATING DISCREPANT ^{238}U CROSS SECTIONS. Bluhm, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). May 1973. 202p. (KFK-1798). (In German and English). Dep. NTIS $13.25.

Work performed under United States-Euratom Fast Reactor Exchange Program.

The measurement and interpretation of neutron spectra in a massive block of depleted uranium are discussed. The construction and test of a ^{3}He-semiconductor sandwich-spectrometer for in-core spectrum measurements in the energy region from 100 keV to 5 MeV are described; this spectrometer is able to discriminate against γ background and to correct for energy losses in the target. By the method used for γ discrimination it is possible to extend considerably the useful energy region of the classical ^{3}He spectrometer. The geometrical efficiency of the spectrometer was calculated by using the Monte Carlo technique; in addition, it was determined experimentally with monoenergetic neutrons. In a number of measurements the reliability of the spectrometer was demonstrated by comparison with other independent techniques. With the aid of the ^{3}He spectrometer and spherical proton recoil counters, the neutron spectra on the axis of a massive block of uranium metal were measured and compared with calculated multigroup spectra. The sensitivity of the spectra against ^{238}U cross section changes was determined by systematic variation of all relevant nuclear data. These sensitivity studies were then used to deduce ^{238}U capture and inelastic scattering cross sections from discrepancies between theoretical prediction and experiment. The ^{238}U cross sections deduced were able to reproduce the measured spectra at all positions of the uranium block axis within the experimental errors. In addition, they led to a considerably better agreement between experimental and theoretical results for other fast zero-power assemblies which are sensitive to ^{238}U cross section changes. (56 figures, 6 tables, 125 references) (auth)

8490 (FRNC-TH-466) RANGE-ENERGY RELATION FOR LOW VELOCITY HEAVY IONS IN A PLASTIC DETECTOR. Applications to the Study of the Fission of Uranium, Thorium, Bismuth, Lead, and Gold Induced by α Particles Having Energies Between 58 and 100 MeV. Ralarosy, J. (Strasbourg-1 Univ., 67 (France)). 1972. 253p. (In French). Dep. NTIS (US Sales Only) $15.75.

Thesis.

Analytical range-energy relations are established for ions in plastic detectors (makrofol). The Bethe formula satisfactorily explains the observed phenomena in the ion energy range under consideration. The expected path lengths (absorption path length) in the material of ions having given energies are considered. This path length is related to the stopping power of the material. The track length that can be made visible in the detector by chemical etching (optically observable path length) is then examined. In general the absorption path length and the optically observable path length differ. These two magnitudes were investigated for ions of atomic number equal or greater than 40 with energies of the order of 10 MeV/nucleon and below. Fission fragment paths were also considered. The fission of ^{238}U, ^{232}Th, ^{209}Bi, ^{207}Pb, and ^{197}Au induced by α particles having energies of less than 100 MeV was studied. The intermediate energy fission mechanism was investigated by observing and carrying out geometrical measurements on the fragments in correlation with known statistical theories and previously established analytical relations. (auth)

8491 (FRNC-TH-470) SOME YIELD MEASUREMENTS IN THE FISSION OF ^{232}Th BY 14-MeV NEUTRONS AND REACTOR NEUTRONS. Chauvin, C. (Grenoble-1 Univ., 38 (France)). 1973. 95p. (In French). Dep. NTIS (US Sales Only) $7.75.

Thesis.

The fission of thorium was studied by envisaging the existence of a symmetric fission. Yield measurements were effected with 14-MeV neutrons and reactor neutrons (0.1 to 10 MeV). The experimental techniques used to irradiate the thorium target are described together with the methods used to measure and treat the radioactive products. The mass distribution curve for the ^{232}Th fission products produced by neutron irradiation represents both symmetric and antisymmetric fission. Symmetric fission, which is highly improbable for reactor neutrons, occurs much more often with 14-MeV neutrons. In the case of ^{115}Cd, the symmetric fission yield varies from 0.05% for reactor neutrons to 1.57% for 14 MeV neutrons. In the case of ^{105}Ru this yield varies from 0.049 to 0.94% i.e., by a factor of 20. In a similar way, the heights of the heavy fission product peaks and the light fission product peaks diminish when the neutron energy reaches 14 MeV. The values for ^{91}Sr and ^{140}Ba vary between 6.8 and 5.72% and 7.4 and 5.9% respectively. (auth)

8492 (JINR-P2-7848) INTERACTION OF HIGH-ENERGY DEUTERON BEAM WITH MATTER. Barashenkov, V. S.; Toneev, V. D.; Chigrinov, S. E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 18p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The Monte-Carlo model is worked out to describe the development of meson-nucleon shower in many-component fissionable matter induced by high energy deuteron beam. Calculations are based on the cascade-evaporation model for inelastic particle-nucleus collisions including the evaporation-fission competition for excited nuclei. The calculation results agree well with the experimental data presently available. As the primary deuteron energy grows from 0.3 to 2 GeV, the thermal energy release and neutron yield on the target increase in magnitude more than by one order. At the energies of T = 0.3 and 1.0 GeV the number of neutrons produced by deuteron beam in uranium target is 1.5 and 1.3 times, respectively, higher than in the case of the proton beam of the same energy and intensity. However, in both cases the neutron yield turns out to be practically equal to each other at T ≥ 2 GeV. Passing from primary proton to deuteron the thermal energy release increases as well as neutron yield. (auth)

8493 (JINR-P6-7759) EXPERIMENTS ON SEARCH FOR SPONTANEOUSLY FISSIONING NUCLIDES OF SUPERHEAVY ELEMENTS IN NATURE. II. Search for Heavy Analog of Lead in Lead Ores and Minerals. Flerov, G. N.; Ter-Akop'yan, G. M.; Getskin, L. S.; Goncharov, G. N.; Popeko, A. G.; Skobelev, N. K.; Gvozdev, B. A.; Tsyb, P. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

With the help of large proportional counters and neutron detectors, a search was made for a spontaneously fissioning heavy analog of Pb in different minerals. A weak effect of spontaneous fission was possibly observed in some lead ores; however, the mechanical and chemical methods of enriching gave no positive result. Under the assumption that the half-life of the superheavy element under search is equal to 10^9 years, its content in the studied samples does not exceed 10^{-13} to 10^{-15} g/g. (1 figure, 3 tables) (auth)

8494 (JINR-P7-7863) DETERMINATION OF REACTION THRESHOLDS IN BOMBARDING ^{208}Pb AND ^{238}U NUCLEI BY ^{40}Ar AND ^{52}Cr IONS. Oganesyan, Yu. Ts.; Penionzhkevich, Yu. E.; Gavrilov, K. A.; Kim De En. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The cross sections for the formation of fission fragments on thin ^{208}Pb and ^{238}U targets were investigated as a function of the energy of ^{40}Ar and ^{52}Cr incident ions. In the ^{238}U + ^{40}Ar reaction, the energy dependences of the yield of products from multinucleon transfer reactions were also studied. By using the dependences obtained, the Coulomb barrier of interacting nuclei and the corresponding effective radius of the interactions were determined. The latter appeared to be constant for all the reactions studied and equal to 1.44 ± 0.02 fermi. The data obtained are compared with the results of different calculations. (auth)

8495 ANGULAR CORRELATIONS OF FRAGMENTS FROM BINARY NUCLEAR FISSION INDUCED BY 1 GeV PROTONS. Kotov, A. A.; Semenchuk, G. G.; Andronenko, L. N.; Andronenko, M. N.; Gorshkov, B. L.; Kovshevnyi, G. G.; Reznik, V. R.; Solya-

kin, G. E. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz., 19: No. 4, 756-760(Apr 1974). (In Russian).

The extracted proton beam of the Leningrad Nuclear Physics Institute synchrocyclotron was used to measure the angular correlations of the binary fission fragments and their energies by means of mosaics of the surface-barrier detectors. The measurements permit one to determine the ratios of the fission cross sections for a number of nuclei to the fission cross section of ^{238}U. The ratios are the following: $(154 \pm 18) \cdot 10^{-3}$ for ^{209}Bi, $(28.8 \pm 1.9) \cdot 10^{-3}$ for ^{197}Au, $(10.8 \pm 1.3) \cdot 10^{-3}$ for the natural W, $(3.25 \pm 0.43) \cdot 10^{-3}$ for the natural Yb. The fissionable nuclei distributions in the transferred momentum obtained from the angular correlation spectra of the pairing fragments have the average values $\langle p_{||} \rangle$ equal to 319 ± 23, 469 ± 24, 542 ± 28, 652 ± 40 and 733 ± 48 MeV/c for the targets made of uranium, bismuth, gold, tungsten and ytterbium, respectively. (auth)

8496 INTERMEDIATE STRUCTURE OF THE GIANT RESONANCE IN HEAVY DEFORMED NUCLEI. Goryachev, B. I. (Moscow State Univ.). Yadern. Fiz.; 19: No. 4, 772-775(Apr 1974). (In Russian).

Effect is considered of decay of quadrupole phonons on the width $\Gamma_\downarrow$ of satellites, predicted by the dynamical collective model of the giant dipole resonance. Correlation between the dipole strength of resonances and their width is noted. The magnitude of $\Gamma_\downarrow$ is estimated and a possibility is discussed to study the intermediate structure of the giant resonance for odd and even-even deformed nuclei in experiment. (auth)

8497 RELATIVE YIELDS OF DELAYED NEUTRONS FROM ^{237}Np FISSION INDUCED BY 0.4 TO 1.2 MeV NEUTRONS. Maksyutenko, B. P.; Balakshev, Yu. F.; Volkova, G. I. (Physical Energy Inst., Moscow). Yadern. Fiz.; 19: No. 4, 748-750(Apr 1974). (In Russian).

The variation of the relative yields of the delayed neutron groups is studied for ^{237}Np fission induced by 0.4 to 1.2 MeV neutrons with 100 keV intervals. (auth)

8498 FISSION OF ^{227}Ac INDUCED BY DEUTERONS. Nikolaev, V. A.; Selitskii, Yu. A.; Funshtein, V. B.; Shestakov, B. I.; Shestakova, I. A. Yadern. Fiz.; 19: No. 4, 751-755(Apr 1974). (In Russian).

The cross sections of the ^{227}Ac fission induced by 4 to 6.8 MeV deuterons are measured. At these energies $\sigma_{d,f} = 10^{-32}$-10^{-31} cm^2. At E_d = 6.8 MeV the spectrum of diameters of the fragments traces in the glass detector with a filter is obtained. The yield of fragments in the vicinity of the peak of the symmetrical fission is determined to be (27 ± 7)% and the anisotropy of the fragments $\sigma_f(0°)/\sigma_f(90°) = 1.20 \pm 0.05$. (auth)

8499 CALCULATION OF THE DECAY POWER OF FISSION PRODUCTS. Tasaka, K.; Sasamoto, N. (Japan Atomic Energy Research Inst., Tokai). Nucl. Sci. Eng.; 54: No. 2, 177-189(Jun 1974).

The energy release rates of fission products were calculated by summation of the contributions of respective fission product nuclides. An attempt was made to refine the existing values of beta- and gamma-ray energy release rates at short times after fission by including information on more fission products, mainly short-lived ones. In the calculation, 443 radioactive and 125 stable nuclides were considered. The unknown nuclear data for short-lived nuclides were estimated theoretically or statistically. Q values were obtained by using the semiempirical mass formula of Myers and Swiatecki. The beta-decay constant, λ, of a nucleus was derived from its Q value by using the empirical correlation between λ and Q. Feasibility of the method was evaluated through comparison of the calculated results with experiment. The results are in good agreement with the experimental results for the gamma-ray energy release rates at short times after the fission; usefulness of the estimated nuclear data is thus indicated. The calculated decay powers are in good agreement with the calorimetric measurements of Day and Cannon. The present results of decay power also agree well with the compilations by Shure and by Stehn and Clancy for the respective cooling times. (9 figures, 3 tables) (auth)

8500 SINGLE-LEVEL ANALYSIS OF THE ^{233}U FISSION CROSS SECTION FOR NEUTRON ENERGIES BETWEEN 6 AND 124 eV. Nizamuddin, S.; Blons, J. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Sci. Eng.; 54: No. 2, 116-126(Jun 1974).

The fission cross section of ^{233}U, measured at liquid nitrogen temperature, was analyzed between 6 and 124 eV by a single-level formalism. The resonance parameters E, Γ, and $\sigma_0\Gamma_f$ are presented. These parameters are shown to represent the measured cross section quite well provided that, in addition to the 136 well-resolved resonances, 33 somewhat broad levels (Γ > 500 MeV) are added in the vicinity of some of the highly asymmetric resonances. The distributions of the nearest-neighbor level spacings are compared with the Wigner distributions. The fission widths, Γ_f, were also derived for only well-resolved resonances, by using a constant value of the radiation width, Γ_γ = 39 MeV. The distribution of these widths compares favorably with a χ^2 distribution with ν = 3 degrees of freedom. (4 figures, 1 table) (auth)

8501 COMPETITION BETWEEN NEUTRON EMISSION AND FISSION FOR ^{234}U, ^{236}U, ^{240}Pu, AND ^{242}Pu COMPOUND NUCLEI. Fubini, A. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 9: No. 17, 682-684(27 Apr 1974).

The existence of the expected bump like structure in the ratio $\Gamma_n/\Gamma\Gamma_f$ of the neutron emission to fission widths for ^{234}U, ^{236}U, ^{240}Pu, and ^{242}Pu is studied. The value of Γ_n/Γ_f was deduced by the fast-neutron cross-sections for ^{233}U, ^{236}U, ^{238}Pu, and ^{241}Pu. No bumplike structure was evident in any of the isotopes studied. (LBS)

8502 STATISTICS FOR ADLER-ADLER RESONANCE PARAMETERS. Rose, E. K.; Cook, J. L.; Bertram, W. K. (Australian Atomic Energy Commission, Sutherland). Aust. J. Phys.; 27: No. 1, 1-11(Feb 1974).

An elementary statistical theory for Adler-Adler resonance parameters is derived, and the experimental results for ^{233}U and ^{235}U are analyzed. Satisfactory agreement is obtained for all parameters. (auth)

8503 ASYMMETRIC TWO-CENTER SHELL MODEL AND MASS DISTRIBUTION IN FISSION. Maruhn, J. (Univ., Frankfurt am Main); Greiner, W.; Lichtner, P.; Drechsel, D. Nukleonika; 19: No. 3, 237-243(1974).

The dynamical fragmentation coordinate ξ $(A_1 - A_2)/(A_1 - A_2)$ is introduced. The collective Hamiltonian $H(R,\dot{\xi})$ is determined within the asymmetric two-center shell model and solved in adiabatic approximation. The mass fragmentation for various fissioning nuclei is calculated parameter free. (auth)

8504 REEVALUATION OF THE SHIELDED NUCLIDE ENERGY DEFICIT IN FISSION. Pickering, M. (State Univ. of New York, Stony Brook). J. Inorg. Nucl. Chem.; 36: No. 5, 959-963 (May 1974).

Ranges of shielded nuclides from fission of ^{233}U and ^{235}U and range data on neutron emitters were transformed into energies using the new Northcliffe-Schilling range-energy formulation. In general, agreement is found with the previous values for the deficit of energy for these species. The neutron emitter range data suggest that the neutron-rich fission fragments may have an "excess" corresponding to the deficit among the shielded nuclides. This would lend support to the hypothesis that the deficit is produced by a neutron boil-off effect. (auth)

8505 RANGES OF FISSION FRAGMENTS PRODUCED BY THERMAL NEUTRON FISSION OF ^{241}Am. Fujiwara, I.; Nakahara, H.; Okamoto, H.; Imanishi, N.; Nishi, T. (Kyoto Univ.). J. Inorg. Nucl. Chem.; 36: No. 5, 965-969(May 1974).

Ranges of 28 mass chains of fission fragments produced by thermal neutron fission of ^{241}Am were measured by the conventional thin-target thin-catcher method. Recoil atoms were collected in either 4π or 2π geometry. Those ranges were converted into kinetic energies and the average total kinetic energy was evaluated to be 172 ± 6 MeV. The present data are compared with the literature values and some discussion is given from the standpoint of systematics. (auth)

8506 NEUTRON CORRELATIONS IN SPONTANEOUS FISSION OF ^{252}Cf. Gavron, A.; Fraenkel, Z. (Nuclear Physics Department, Weizmann Institute of Science, Rehovoth, Israel). Phys. Rev. C 9: No. 2, 632-645 (Feb 1974).

The variance and covariance of the neutron distributions in fission fragments of ^{252}Cf have been measured as a function of the fragment mass and total kinetic energy. The neutrons were detected by a time-of-flight technique. The covariance results indicate that there is no change in the degree of viscosity in the transition of the fissioning nucleus to the scission point as a function of the total excitation energy. There are some discrepancies between various features of the neutron evaporation cascade determined in our experiment and results of standard evaporation calculations. No simple explanation of these discrepancies is offered. (auth)

8507 INDUCED DECAY OF THE NEUTRAL VACUUM IN OVERCRITICAL FIELDS OCCURRING IN HEAVY-ION COLLISIONS. Smith, K.; Peitz, H.; Müller, B.; Greiner, W. (Institut für Theoretische Physik der Universität Frankfurt, Frankfurt am Main, Germany). Phys. Rev. Lett. 32: No. 10, 554-556 (11 Mar 1974).

In critical or nearly critical heavy-ion collisions, induced as well as spontaneous energyless e^-e^+ pair creation result in the decay of the neutral vacuum. Induced transitions from the negative-energy continuum into a vacant molecular 1s level can occur even in the absence of diving and produce a susbstantial enhancement and broadening of the

previously considered spontaneous positron spectrum. Total cross sections of 5 b have been calculated for U–U collisions. (auth)

8508 THEORY OF FISSION-MASS DISTRIBUTIONS DEMONSTRATED FOR ^{226}Ra, ^{236}U, ^{256}Fm. Maruhn, J.; Greiner, W. (Institut für Theoretische Physik der Universität Frankfurt, Frankfurt am Main, Germany). Phys. Rev. Lett. 32: No. 10, 548-551 (11 Mar 1974).

With the mass asymmetry described by the dynamical collective fragmentation coordinate ξ, and with use of the asymmetric two-center shell model, the fission mass distributions for ^{226}Ra, ^{236}U, and ^{256}Fm (which are typical representatives for triple-, double-, and single-humped distributions) are explained. (auth)

8509 INVESTIGATION OF THE γ DECAY OF SUBTHRESHOLD-FISSION RESONANCES OF ^{242}Pu TO A FISSION ISOMERIC STATE. Browne, J. C.; Bowman, C. D. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. C 9: No. 3, 1177-1185 (Mar 1974).

A pure class-II state can be defined in terms of a double-humped fission barrier as a state in the second well which has two modes of decay: fission through the outer barrier (Γ_{fII}) and γ decay ($\Gamma_{\gamma II}$) to the ground state in the second well (fission isomer). The purpose of this experiment was to measure the branching ratio ($\Gamma_{\gamma II}/\Gamma_{fI}$) for an almost-pure class-II state in the ^{242}Pu + n system, thereby establishing for the first time a direct connection between fission intermediate structure and shape isomerism. A 10-g sample of ^{242}Pu was bombarded by neutrons from the Livermore 100-MeV linac. Both the energy of a neutron inducing an event and the time relationship between γ rays detected in a pair of C_6D_6 scintillators were stored in a two-dimensional matrix consisting of 7.7×10^5 channels. Analysis of subthreshold fission groups at neutron energies of 763 and 1839 eV showed no evidence of a γ-decay branch to the 33-nsec fission isomer in ^{243}Pu. From the limit on the branching ratio ($\Gamma_{\gamma II}/\Gamma_{fI}$) obtained from these data, an upper limit of $\Gamma_{\gamma II}<1$ meV was derived. Since theoretical calculations predict $\Gamma_{\gamma II}\simeq8$–10 meV for ^{243}Pu, the experiment had a sensitivity which is a factor of 10 lower than should have been necessary to observe the γ decay to the fission isomer. From the present results and from previous measurements on ^{243}Pu, we are led to the conclusion that there may exist an additional longer-lived isomer in ^{243}Pu similar to the other odd Pu isotopes. (auth)

Nuclear Theory

Refer also to abstracts 6183, 6642, 7918, 8164, 8202, 8247, 8274, 8282, 8283, 8360, 8376, and 8448.

8510 (BARC/I-135, pp 76-78) EXCITATION FUNCTIONS FOR THE NEUTRON INDUCED FISSION OF HEAVY NUCLEI. Iyer, R. H.; Sagu, M. L. (Bhabha Atomic Research Centre, Bombay). 1971.

Experiments were carried out to measure the fission cross sections of several nuclei namely ^{233}Th, ^{233}U, ^{239}Pu and ^{241}Am relative to that of ^{235}U in the neutron energy range of 0.32 to 2.1 MeV at energy intervals of about 100 keV. Fission events were recorded using solid state track detector (Lexan poly carbonate). The fission cross section of ^{241}Am (n,f) was obtained. The measured cross sections are in fair agreement with results of measurements from other laboratories. (AK)

8511 (CONF-740218-(Absts.)) 5th AINSE NUCLEAR PHYSICS CONFERENCE AT THE AUSTRALIAN NATIONAL UNIVERSITY, 11TH, 12TH, AND 13TH FEBRUARY 1974. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). 1974. 100p.

Abstracts of 85 papers presented at the 5th AINSE Nuclear Physics Conference are given. The sessions were devoted to the following topics: Nuclear matter, Neutron capture & nucleosynthesis, Few-body problem, Techniques and applications, Recent accelerator developments at the ANU, Collective effects in nuclei, Collective effects and capture reactions, Particle physics and weak interactions, Nuclear reactions, Particles and nuclei, Gamma transitions, α particles in nuclei, Heavy-ion reactions/Beta decay, and Scattering processes. The last session of the conference was a general session. (RWR)

8512 (FEI-327) DENSITY OF EXCITED PARTICLE-HOLE STATES. Ignatyuk, A. V.; Sokolov, Yu. V. (Gosudarstvennyj Komitet po Ispoi'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 18p. (In Russian). INIS.

A description of the statistical characteristics of excited particle-hole states of nuclei was examined for different models of the one-particle spectrum. The spin dependence of the density of these states was obtained. The effect of discrete structures of the spectrum of the shell model levels on the behavior of the .. thermodynamic functions of the excited nucleus was studied. It was shown that because of the shell inhomogeneities the density of the particle-hole states can be significantly different from the results obtained within the framework of the continuous spectrum gas approximation. (tr-auth)

8513 (FRNC-TH-428) HIGH ENERGY ELASTIC AND QUASI ELASTIC COLLISIONS BETWEEN TWO NUCLEI AND THE RIGID PROJECTILE MODEL. Tekou, A. B. (Paris-11 Univ., 91-Orsay (France)). 1972. 87p. (In French). Dep. NTIS (US Sales Only) $7.50.

Thesis.

A detailed study of elastic and quasi-elastic deuteron-nucleus transitions is presented. Particular emphasis is given to the problem of diffractional decay. The Glauber theory of multiple scattering extended to the case of collisions between two nuclei enables the problem to be resolved, although the calculation is extremely difficult. It becomes necessary to develop a method or a model which is more correct than the opaque nucleus model and which allows cross sections to be easily calculated with a high accuracy. An approximation model deduced from the Glauber theory is proposed, the rigid projectile model. When the nucleus in the collision is light (deuteron, helium), exact calculations can be effected using the Glauber theory. Studies of the characteristic behavior obtained enable the parametrization shape of the deuteron wave function used in the analysis of deuteron-heavy nucleus collisions to be analyzed. Investigations of the connection between the Glauber theory and the opaque nucleus model enabled the rigid projectile model to be extended to cover heavier nuclei than the deuteron. This model enabled the absorption cross section of these nuclei for antideuterons to be calculated. The cross section obtained for coherent decay decreases with the mass number of the nucleus in collision, while the incoherent scattering cross section increases. It is shown that incoherent decay is the most important effect in all quasi-elastic collisions; its cross section is about 2.5 times that of coherent scattering. In addition, incoherent decay is responsible for the quasi-totality of the total cross section for deuteron decay when heavy nuclei collide with deuterons. (auth)

8514 (JEN-257) LEVEL SCHEME OF ^{223}Fr. Gaeta, R.; Gonzalez, J. A.; Gonzalez, L.; Roldan, C. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 107p. (In Spanish). INIS.

A study was made of the decay of ^{227}Ac at levels of ^{223}Fr, by means of alpha Spectrometers of Si barrier detector and gamma Spectrometers of Ge(Li). The rotational bands 1/2-(541), 1/2-(530) and 3/2-(532) were identified, as well as two octupolar bands associated with the fundamental one. The results obtained indicate that the unified model is applicable in this intermediate zone of the nuclide chart. (auth)

8515 (JINR-E4-7804) INFLUENCE OF THE SHELL STRUCTURE ON THE MOMENT OF INERTIA. The Average Behavior of the Moment of Inertia. Frauendorf, S.; Pashkevich, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 26p. Dep. NTIS (US Sales Only) $4.50.

In order to investigate the influence of the shell structure on the moment of inertia, expressions for the averaged moment of inertia and the shell contribution are proposed. By numerical calculations the plateau condition, which justifies the proposed partition, is shown to be fulfilled. Both types of the moment of inertia are calculated as a function of the particle number and the deformation and are compared with the rigid body value of the moment of inertia and that of a heated nucleus. The order of magnitude of the shell effects at the equilibrium deformation is investigated and some situations, in which these effects are expected to be large, are suggested. (auth)

8516 (LYCEN-7345) STUDY OF CERTAIN TYPES OF SEPARABLE NONLOCAL NUCLEON-NUCLEON INTERACTIONS IN INFINITE NUCLEAR MATTER. Meunier, J. P. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire). Jun 1973. 109p. (In French). Dep. NTIS (US Sales Only) $8.50.

Thesis.

It is shown possible to construct separable nonlocal interactions which are more than a simple parametrization of the phase shifts. These interactions must provide a correct description of the phase shifts below 400 MeV as well as of the low energy parameters. In addition, they must be capable of reproducing the three-body observables for both bound and free states as well as the saturation properties of infinite nuclear matter (I.N.M.) and the properties of real finite nuclei wherever the latter is possible. The I.N.M. concept enables the off-shell behavior of the interaction to be investigated this test being absolutely necessary when further studies of the properties of finite nuclei are to be undertaken. It is also shown that this concept allows the problem of determining self-consistent individual wave functions of the Brueckner-

Hartree-Fock theory for finite nuclei to be eliminated because plane waves are considered in the treatment presented. First order Brueckner theory is used together with the generally accepted approximations; in the absence of precise information on the contribution of three-body clusters, it is assumed that U(b) = 0. The principal characteristics of I.N.M. are subsequently deduced: binding energy per particle, saturation density, coefficient of compressibility, and the K parameter. It is shown that Mongan type interactions give rise to over-binding and supersaturation (an insufficiently large tensorial part). A better description of the tensor force of the $^3S_1 + {}^3D_1$ coupled waves appreciably modifies the results obtained for the binding energy and saturation densities. (auth)

8517 METHOD OF GENERATING FUNCTIONS FOR THE CALCULATION OF MATRIX ELEMENTS IN THE DEFORMED-HARMONIC OSCILLATOR BASIS. Hasse, R. W. (Univ., Heidelberg). Ann. Phys. (N. Y.); 80: No. 1, 118-141(Sep 1973).

The method of generating functions which was previously only employed for the spherical basis of harmonic-oscillator single-particle wave functions is generalized to the deformed (= cylindrical = asymptotic) basis. One-center and two-center matrix elements which are important in fission or heavy-ion scattering theories are obtained for various operators and potentials, i.e., spin-orbit, l-squared, Gaussian, or Gaussian multiplied by a polynomial, etc. If they cannot be calculated explicitly, recurrence formulas are evaluated. The method circumvents integrating the matrix elements by the introduction of generating parameters and looking for the coefficient of some power of the generating parameter in the expansion of the generating function. The method is further simplified by transforming the operators acting on the wave functions into operators which act onto the generating function or into functions to be multiplied by the generating integral. (auth)

8518 NUCLEON PAIR ENERGIES AND SURFACES OF NUCLEAR BINDING ENERGIES. Kravtsov, A. V.; Kravtsov, V. A.; Maksimov, D. A. (Leningrad Polytechnic Inst.). Yadern. Fiz.; 19: No. 4, 761-771(Apr 1974). (In Russian).

Variation of the pair energies calculated from the experimental binding energies is studied. It is established that the pair energies decrease with the nucleon number, on average, evidently more slowly than $A^{-\frac{1}{3}}$, $N^{-\frac{1}{3}}$ or $Z^{-\frac{1}{3}}$. Deviation from the average behavior of the pair energies is a result of the nuclear shells and of the deformation of the nuclei. The fact that the deviations in the pair energies do not coincide strictly with the magic numbers is due to various positions of the shell valleys on the energy surfaces. The shell valleys may be compared by deviations of the pair energies and by the efficiencies of breaks on the energy surfaces. It is stated that the behavior of the efficiencies and deviations is different for oscillator shells, spin-orbit shells and deformed nucleus shells. Variation of the residual neutron-proton interaction is studied as well as effect of shells and deformations on the variation. (auth)

8519 FLUCTUATIONS OF SENIORITY AND MOMENT IN THE HARTREE-FOCK METHOD AT DEFORMATION OF ATOMIC NUCLEI. Medvedev, B. I. (Moscow Evening Metallurgical Inst.). Yadern. Fiz.; 19: No. 4, 776-782(Apr 1974). (In Russian).

Distributions of the seniority, total moment and moments of the subsystems in the Hartree-Fock wave functions are calculated. It is shown that in case the shell occupation number is small the seniority may be considered as a good quantum number and the relative fluctuations of the subsystem moments are small. (auth)

8520 ENERGY OF DEFORMATION OF NUCLEUS BY STATIC EXTERNAL FIELD. Strutinskii, V. M. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 19: No. 4, 783-791(Apr 1974). (In Russian).

In the Hartree-Fock approximation the energy of a nucleus in an external field is expressed in terms of two subsidiary density matrices. The flattened distribution $\bar{\rho}$ represents the change of the nuclear shape, and the one-particle potential related to it is identified with the nonself-consistent deformed potential of the shell model. Another distribution ρ^{ε} gives the volume polarization of the nucleus by the external field. The obtained expression admits normalization of smooth components by means of liquid-drop and statistical models of the nucleus. (auth)

8521 COLLECTIVE PROPERTIES OF A DROPLET OF FERMI LIQUID. Kodel, V. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 19: No. 4, 792-808(Apr 1974). (In Russian).

Collective properties of a droplet of the Fermi liquid are investigated. Self-consistency conditions for the surface characteristics of the droplet arising from violation of the translation invariance are analyzed in detail. It is shown that in the problem in view the Goldstone excitations arising in every system from violation of a symmetry are the surface collective vibrations. Equations to determine characteristics of the spectrum are obtained. It is found that at sufficiently large L the spectrum of the surface excitations is described by the hydrodynamical formula $\omega_L^2 \sim \epsilon_L^2 L^3/A$. A formula is obtained for the surface tension coefficient of the droplet that enables one to calculate it if the surface characteristics of the quasiparticle Hamiltonian and their interaction are known. The problem is analyzed of variation of the system density $\rho(r)$ at variation of number of the particles. It is shown that by adding one or several particles one changes the density $\rho(r)$ mainly near the boundary. The change is in agreement with the variation of $\rho(r)$ resulting from increasing of the system radius according to the law $R = r_0 A^{\frac{1}{3}}$. The formulas obtained for the frequencies and probabilities of the collective transitions are compared with the formulas of the collective model. (auth)

8522 K_{min} APPROXIMATION IN THE K-HARMONICS METHOD FOR VARIOUS NUCLEON-NUCLEON POTENTIALS. Aver'yanov, I. K. Yadern. Fiz.; 19: No. 4, 809-812(Apr 1974). (In Russian).

Contribution from the K_{min} approximation to the binding energy of double-magic nuclei in the conventional oscillator closure scheme is considered in the work. Several nucleon-nucleon potentials are considered, some satisfying and other not satisfying the experimental data on the low energy scattering. It is shown that for realistic nucleon-nucleon potentials the contribution from the K_{min} approximation to the binding energy of known nuclei is no more than ~40 to 50%. Omitting the equality of the potentials for free nucleons and the nucleons bound in the nucleus, the contribution may be increased up to ≳75%. The problem of possible parametrization of the K-harmonics method in its basic approximation is stated. (auth)

8523 WHAT LIMIT VALUES DOES EITHER PHASE OF DIRECT AND CROSS REACTION AMPLITUDES TEND?. Medvedev, S. Yu. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 19: No. 4, 930-935(Apr 1974). (In Russian).

The relations are obtained connecting the asymptotic behavior of either phase of direct and cross reactions amplitudes with two parameters: the degree of energy dependence of amplitudes in the asymptotic region, and the value of the ratio of antisymmetric part of the amplitudes to the symmetric one in this region. (auth)

8524 PHYSICS 50 YEARS LATER. Brown, S. C. (ed.). Washington, DC; National Academy of Sciences (1973). 428p. $11.00.

The memorial volume of the fiftieth anniversary of the founding of the IUPAP contains 16 papers on various branches of physics outlining the present status and speculating on future directions. Separate abstracts were prepared for five of the included papers. (MOW)

For abstracts of individual papers see: 6246, 7544, 8140, 8525, and 8599.

8525 MANY FACETS OF NUCLEAR STRUCTURE. Bohr, A. (Univ. of Copenhagen); Mottelson, B. R. pp 244-273 of Physics 50 Years Later. Brown, S. C. (Ed.). Washington, DC; National Academy of Sciences (1973).

The discussion of nuclear structure covers the early developments, the nucleus as a quantal many-body problem, interplay of shell structure and nuclear deformations, interactions of nuclear matter in bulk (heavy-ion reactions), elementary modes of excitation: unified description, fine-grain structure of nuclear matter: mesonic degrees of freedom, statistics of quantal states of the compound nucleus, the strength function for direct interactions, and the isobaric analog resonance. Also discussed are collective modes in the nuclear pair field (two-particle transfer reactions), rotational spectra, generalized rotational motion, phase transitions induced by rotational perturbation in the Yrast region, and connections to other fields. (JFP)

8526 ASYMPTOTIC BEHAVIOR OF THE ASYMMETRY PARAMETER IN FISSION. Reinhard, P. G.; Lichtner, P.; Drechsel, D. (Univ., Mainz, Ger.). Phys. Lett.; 49B: No. 4, 315-317(29 Apr 1974).

In a two-center-shell-model description of asymmetric fission one works with a continuous asymmetry parameter ξ. After the scission point, however, the mass distribution can change only in steps of whole nucleons. A generator-coordinate consideration shows how ξ discretises in that it separates into intervals belonging to different mass distributions. At the boundaries of the intervals infinite walls build up which decouple the spaces dynamically, hindering any transfer. For practical purposes a parametrisation is given for the walls which have to be added to the usual collective Hamiltonian obtained from a cranking theory. (auth)

8527 CONTRIBUTIONS TO THE PION-NUCLEUS OPTICAL POTENTIAL NONLINEAR IN NUCLEAR DENSITY: THE ERIC-

SON–ERICSON LORENZ–LORENZ CORRECTION. Klein, A.; Rafelski, J. (Univ. of Pennsylvania, Philadelphia). Phys. Lett.; 49B: No. 4, 318-322(29 Apr 1974).

A well-defined set of higher order corrections to the lowest order pion–nucleus optical potential is examined within the framework of many-body theory for an infinite nuclear medium. The connection between the pion self-energy operators and multiple scattering formalisms in thereby indicated and a derivation of the EELL effect given. (auth)

8528 RENORMALIZATION OF ONE BODY OPERATORS AND NUCLEAR STRUCTURE STUDIES WITH DENSITY DEPENDENT INTERACTIONS. Zamick, L.; Sharp, R. (Rutgers–The State Univ., New Brunswick, NJ). pp 1-22 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

The article begins by discussing radial self-consistency and the energies of collective states (the collective states, radial self-consistency and the realistic nuclear force, the delta interaction, density-dependent delta interactions, calculations for ^{16}O and ^{40}Ca, and energies of collective states); energies of collective states in ^{16}O and ^{40}Ca using the delta interaction and the self-consistent density-dependent interaction, and energies of collective states in ^{16}O and ^{40}Ca using the Moszkowski–Ehlers, the Vautherin–Brink, and the Kallio–Kolltveit interactions are tabulated. Aspects of the latter table commented upon include the following: the difference between zero range and finite range, the energy of the spurious state, the effect of density dependence, and the connection with multipole–multipole forces used by the Copenhagen group. The remaining sections of the paper are headed as follows: effective charge—isoscalar; E(O) effective charges; isovector problems; the relationship between the renormalization of the one-body operators and of the two-body interaction—^{208}Pb and ^{210}Pb; and E(O) transitions in ^{208}Pb. This work seems more like a collection of lecture notes on various topics than a finished paper. (2 figures, 4 tables) (RWR)

8529 THEORY OF ELEMENTARY EXCITATIONS IN SPHERICAL NUCLEI. Kanesaki, N. (Kyushu Univ., Fukuoka); Kuriyama, K.; Marumori, T.; Matsuyanagi, K.; Sakata, F.; Takada, K. pp 69-76 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

The basic idea and outline of a new systematic microscopic theory to describe elementary excitations in spherical nuclei are presented. The theory is being presented in the form of a series of papers, some parts of which have recently been published. (3 figures) (auth)

8530 YRAST LINE AND THE ASYMMETRIC ROTOR MODEL. Sugawara-Tanabe, K. (Tokyo Univ.). pp 107-113 of Proceedings of the Symposium on In-Beam Spectroscopy With Heavy Ions. Kamitsubo, H. (ed.). Wako, Japan; Inst. of Physical and Chemical Research (1973).

From symposium on in-beam spectroscopy with heavy ions; Saitama, Japan (1 Sep 1972). See CONF-7209112-.

The systematic absence of traps suggests that the levels in the yrast region have considerable regularity, and the collectiveness and the short feeding time suggest the mixing of K, the projection of angular momentum on the symmetry axis. The asymmetric rotor model is a particularly simple one fulfilling these requirements. The Hamiltonian is constructed and diagonalized, and an expression for the yrast line is obtained. The various properties of the high-spin states of Er are well interpreted qualitatively by the model. (4 figures, 1 table) (RWR)

8531 THREE BODY FORCES. Noyes, H. P. (Stanford Linear Accelerator Center, CA). pp 122-134 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A rigorous definition of the "three-body problem" in nuclear physics is given. The conventional approaches, of fitting a local potential which asymptotically becomes an OPE potential were not able to predict, say, the binding energy of triton. This was estimated to be ~6.5 MeV; latest measurements give 8 to 4 MeV. A model using only on-shell two-body data and an elementary three-body interaction may, however, be able to provide a more accurate picture. (CMS)

8532 FAST-NUCLEON RADIATIVE CAPTURE AND THE EFFECT OF THE GIANT DIPOLE RESONANCE. Cvelbar, F. (Univ. of Ljubljana, Yugoslavia); Whetstone, S. L. pp 271-291 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

A brief review is given of the direct–semidirect model for radiative capture of fast nucleons including some recent refinements to the theory. Comparisons of the model with recent experimental data on proton and neutron radiative capture are presented. Although fairly good agreement between measured and calculated excitation functions is found, there are some obvious remaining discrepancies, notably the fact that effects expected from interference between direct and semidirect processes do not seem to appear in the experimental data. Concluding remarks are made concerning future prospects for capture experiments, some of which (chiefly involving 14-MeV neutrons) can still be tackled by small laboratories working with low-energy accelerators. (14 figures) (auth)

8533 JASTROW CLUSTER EXPANSION METHOD FOR FINITE NUCLEI. Warke, C. S.; Gunye, M. R. (Tata Inst. of Fundamental Research, Bombay). J. Phys., A (London); 7: No. 6, 718-727(11 Apr 1974).

The binding energies and rms radii of nuclei in the mass region $16 \leq A \leq 208$ are calculated in the Jastrow cluster expansion method [Phys. Rev.; 98: 1479-1487(1955)] by including the second-order correction to the energy. The Reid [Ann. Phys.; NY 50: 411-448(1968)] soft-core NN interaction has been employed in the calculations. The binding energies are predicted reasonably well for the nuclei in the mass region $A \sim 90$, whereas they are underestimated in nuclei with $A < 56$ and overestimated in nuclei with $A > 120$. The calculated rms radii are in good agreement with the experimental data for nuclei with $A \leq 56$ but not for heavy nuclei, where considerable compression is predicted. The contribution of the three-body cluster correction to the two-body correlation energy is estimated to be at the most 9%, thereby indicating a good convergence of the cluster expansion. The results are compared with those recently obtained from the Brueckner–Bethe–Goldstone method using the same NN interaction [Davies et al., Phys. Rev.; C 6: 1461(1972)]. (auth)

8534 NOVEL PROJECTION TECHNIQUE IN NUCLEAR STRUCTURE CALCULATIONS. Morrison, J.; Watt, A.; Whitehead, R. R. (Univ. of Glasgow). J. Phys., A (London); 7: No. 6, L75-L79(11 Apr 1974).

An exact projection technique based on the Lanczos algorithm is presented for calculating eigenstates of an operator. The method is directly applicable to any intrinsic state expressible in terms of a sum of Slater determinants, does not depend on intrinsic symmetries, and can be used to project eigenstates of any one- or two-body operator. (auth)

8535 STUDIES OF THE RESONANCE PHENOMENA BY AN EXACTLY SOLUBLE THREE-BODY MODEL. Beregi, P. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 318-321 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A three-body model suitable for the investigation of the resonance phenomena has been presented. This model consists of three particles, two (particles 1 and 2) with finite and equal masses and the third particle, the core (C) being an infinitely heavy one. The interactions $V(\alpha,3)$ between the light particles $\alpha(\alpha = 1,2)$ and the core are chosen to allow two bound states or one bound state and one single particle resonance state in the subsystems α-3, and the particles α are called "neutrons" (n) or "protons" (p), respectively. In investigating the "C + p + p" system the negative total energy calculations for the model are completed. The two-particle interactions $V(\alpha,3)$ were chosen in the form of two-term separable ones. The "single-particle" energy levels in the "C + p" systems are presented. In the "C + p + p" system two different many particle resonances can occur, namely the potential and the quasi-compound ones. These resonances were investigated, varying the p-p interaction strength λ and the corresponding exact elastic scattering cross sections calculated. (auth)

8536 QUASIPARTICLE CALCULATIONS FOR THE THREE-NUCLEON SYSTEM. Alt, E. O.; Sandhas, W. (Univ., Mainz). pp 314-317 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few parti-

cle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

There are three methods for solving the integral equations for the three-body problem with local two-body potentials. One consists of the direct solution of the Faddeev equations and the other two make different use of the quasiparticle idea which is based on the splitting of the occurring two-body potentials into a sum of separable terms and a rest potential. Some results obtained with the quasiparticle method for the three-nucleon system employing central, purely attractive, spin dependent Yukawa potentials are presented. (auth)

8537 SPURIOUS STATES AND HOW TO GET RID OF THEM. Schmid, E. W. (Univ., Tuebingen, Ger.). pp 343-346 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

There are several reaction theories which can yield numerical results in the few nucleon problem. These theories are characterized by approximation in the interaction potential and by approximations in the solution of the Schroedinger equation. The latter approximations are discussed with particular reference to the integro-differential equations approach of the cluster model and of the shell model reaction theory. These theories are based on a truncation of Hilbert space. Truncations of Hilbert space enter into the theory at two points. The wave function ψ is taken from a truncated space. The vector $(H-E)\psi$ is minimized in a truncated space. The second point is discussed. Usually, one simply demands that $(H-E)\psi$ has zero components in the space from which ψ is taken, which means that one diagonalizes H in $\mathfrak{H}_t$. Components of $(H-E)\psi$ outside of $\mathfrak{H}_t$ are neglected altogether. This neglect causes spurious resonances. The suppression of these false resonances is discussed. (auth)

8538 BREAK-UP REACTIONS IN A THREE-PARTICLE MODEL. Berggren, T.; Ohlen, G. (Techniska Hoegskolan, Lund, Sweden). pp 322-324 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Co. (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

It was shown that resonant states can be treated in the same way as bound states if a suitable norm concept is introduced. A three-particle model for a break-up reaction, where the incoming channel consists of one free particle (α) and two particles (β and γ) bound to each other is discussed. In the outgoing channel all particles are free. In particular the situation when, due to final state interactions, two particles are in a relative resonant state is considered. In order to solve the Lippmann–Schwinger (LS) equation for the T matrix an operator multiplier technique is used. (auth)

8539 EXCHANGE POTENTIALS IN RELATIVISTIC HARTREE-FOCK THEORY OF CLOSED-SHELL NUCLEI. Miller, L.D. (University of Maryland, College Park, Maryland 20742). Phys. Rev. C 9: No. 2, 537-554 (Feb 1974).

The relativistic Hartree formalism for nuclei is extended to include the exchange potentials which result from various kinds of one-boson-exchange interactions. A numerical simplification is presented which uncouples the relativistic Hartree-Fock equations and enables local (though state-dependent) single-particle potentials to be defined for the exchange interactions. Calculations are presented for a vector-scalar nucleon-nucleon force model. Comparison of these calculations with Hartree calculations (using the same model) indicates that the exchange terms contribute a net attraction of about 1.5 MeV per particle in light nuclei, while rms radii are reduced by about 0.03 fm. A study is also made of the exchange potentials resulting from the pseudoscalar part (one-pion-exchange) of the nucleon-nucleon interaction. These terms appear to be important, although self-consistent calculations are not possible in the present framework due to numerical instabilities induced by the pseudoscalar term. The instabilities appear to be related to an incorrect enhancement of the effects of virtual N–$\bar{N}$ pair creation which is present in the coordinate space relativistic one-pion-exchange potential. (auth)

8540 FINITE-RANGE FULL-RECOIL CALCULATION FOR TWO-NUCLEON TRANSFER BETWEEN HEAVY IONS. Bayman, B.F. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. Lett. 32: No. 2, 71-74 (14 Jan 1974).

A distorted-wave Born-approximation (DWBA) calculation has been done for the reaction ^{62}Ni(^{18}O, ^{16}O)^{64}Ni, in which full account is taken of finite-range and recoil effects. It is found that finite-range no-recoil calculations for this reaction overestimate the DWBA cross-section by about a factor of 5. The no-recoil result concerning the strong dependence of the cross section on the single-particle states involved is confirmed by this full-recoil calculation. (auth)

8541 SELF-CONSISTENT QUASIPARTICLE-PHONON COUPLING. Immele, J.D. (Sektion Physik der Universität München, 8046 Garching, Germany); Struble, G.L. Phys. Rev. C 9: No. 2, 460-472 (Feb 1974).

Using a Green's function formalism, the quasiparticle self-energy in a finite Fermi system is derived from the particle-particle-hole response function with the assumption that particle-particle and three-body correlations are negligible. An approximate calculation of the self-energy includes the usual core-polarization diagram, a backwards exchange diagram with ground-state correlations, and higher-order diagrams which correct for exclusion-principle violations in the propagation of the quasiparticle and the microscopic phonon. Intermediate lines in the self-energy are described self-consistently, thereby including multiple-phonon core excitations. It is shown that the equation for the self-energy may be solved by matrix diagonalization by coupling the even- and odd-nuclear eigenmodes. Renormalized phonons are calculated by taking into account the distribution of quasiparticle strength by quasiparticle-phonon coupling in the solution of the Bethe-Salpeter equation. The self-energy and phonon are calculated self-consistently. (auth)

8542 TRANSITION INTENSITIES FROM PROJECTION-INTEGRAL WAVE FUNCTIONS. Adler, C.G. (Department of Physics, East Carolina University, Greenville, North Carolina 27834). Phys. Rev. C 9: No. 2, 498-500 (Feb 1974).

Possible deviations from the Alaga rules based on the use of projection-integral wave functions are investigated. It is shown that while such deviations, in principle, exist, they identically vanish in the region of heavy deformed nuclei, if it is assumed that these nuclei can be described by "semirigid" intrinsic wave functions. (auth)

8543 THEORY OF MEAN REMOVAL ENERGIES FOR SINGLE PARTICLES IN NUCLEI. Koltun, D.S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. C 9: No. 2, 484-497 (Feb 1974).

A useful way to characterize the hole-energy spectrum excited in a direct particle-removal reaction like (p, 2p) or (e, e'p) is through the centroid or mean removal energy. We derive the rules for computing this quantity in a linked-cluster expansion, and give some examples. We demonstrate the close relation of the mean removal energy to Brandow's self-consistent orbital energy, and discuss briefly the connection with Green's function theory. (auth)

8544 STATISTICAL ANALYSIS OF INTERMEDIATE STRUCTURE. Baudinet-Robinet, Y. (Physics Department, University of Liège, 4000-Liège, Belgium); Mahaux, C. Phys. Rev. C 9: No. 2, 723-740 (Feb 1974).

We study several statistical tests which can be used to determine whether experimental data, typically a sequence of partial widths, are compatible with the statistical model of nuclear reactions or, on the contrary, imply the existence of intermediate structure. These tests are applicable to cases where the data can be ascribed to a definite partial wave. We give a brief, but critical, discussion of the few known methods, and develop several new tests. These new tests involve the study of the following quantities: (a) the length of the longest unbroken sequence (run) of partial widths lying either above or below their median, (b) the length of the longest run about a value that we call the value of optimal run length, (c) the distribution of runs up or down, i.e., of unbroken sequences composed of increasing or decreasing values, (d) the number of large adjacent partial widths, and (e) the ratio of the mean-square successive difference to the variance. We apply these new tests and the previously known ones, and discuss their merits and drawbacks, in the examples ^{40}Ca(p, p'), ^{56}Fe(n, n), ^{244}Cm + n, ^{187}Re(n, γ), ^{115}In(n, γ), ^{90}Zr + γ, Sn + γ, ^{70}Ge(p, p), ^{239}Pu(n, f), and ^{206}Pb(n, n). We find reliable evidence for intermediate structure in all these cases, except in the reactions ^{187}Re(n, γ) and ^{115}In(n, γ). (auth)

8545 VALIDITY OF A NEW APPROACH TO COLLECTIVE NUCLEAR MOTIONS. Bose, S.; Varshni, Y.P. (Department of Physics, University of Ottawa, Ottawa, Canada K1N 6N5). Phys. Rev. C 9: No. 2, 777-781 (Feb 1974).

Morinigo has used the elements of the mass quadrupole tensor as generalized nonredundant variables to describe the nuclear collective motions and has obtained an energy equation which is similar to that of the variable-moment-of-inertia (VMI) model. Applicability of the Morinigo expression to the level energies of the ground-state bands of even-even nuclei is examined and results are presented for 12 representative nuclei. It is found that for the soft nuclei the results are not as good as those from the VMI23 extension of the VMI model. (auth)

8546 THE PAIRING MODEL. Broglia, R.A. (The Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark,). Ann. Phys. (N.Y.) 80: No. 1, 60-85 (Sept 1973).

The consequences of the existence of pairing correlations in nuclei are

discussed. Special attention is paid to the dynamical aspects of the pairing degree of freedom, as revealed by two-nucleon transfer reactions. These reactions constitute specific probes of the pairing collective modes. The mathematical framework in which the discussion is carried out is the BCS theory and the Random Phase Approximation. The bordeline aspect of the subject, which lies between solid state and nuclear physics is emphasized, pointing out the similarities and differences between analogous phenomena of solid and nuclear physics. (auth)

8547 THREE BODY RESONANCES IN A COUPLED CHANNEL N/D APPROACH. Kac, M. (Department of Theoretical Physics, 12 Parks Road, Oxford, OX1 3PQ, England). Ann. Phys. (N.Y.) 81: No. 1, 113-153 (Nov 1973).

Assuming a three body channel to be dominated by the formation of bound states and resonances, the three body problem is reduced to an effective two body coupled channel problem in which pairs of particles, either bound states or resonances, scatter from the remaining third particle. We treat this effective two body problem by the partial wave matrix N/D method. We study in particular a coupled two channel problem, one channel consisting of one resonance plus one particle, the other of one bound state plus one particle. Our main purpose is to investigate in a full coupled channel situation the possible generation of three particle resonances. With single particle exchange forces forming the dynamical input to the N/D integral equations, enhancements are generated in a spinless model which correspond to three-particle resonances. The model is then applied, with spin included, to the $p+p+^{12}C$ system at low energy, in which ($p+^{12}C$) can form either the bound state ^{13}N(G.S.) or the resonance $^{13}N^*$ (1.944 Mev); the two channels are then $p+^{13}N$(G.S.) and $p+^{13}N^*$. The p-p interaction is neglected. It is found that the main effect in this case is the force arising from the coupling of the channels, which is sufficiently strong to generate a three particle level in the composite system ^{14}O. (auth)

8548 MECHANISMS OF HEAVY ION REACTIONS FROM A MACROSCOPIC VIEWPOINT. Blann, M. (Univ. of Rochester, NY). Nukleonika; 19: No. 3, 203-236(1974).

Theoretical considerations concerning the height of the fusion barriers for heavy ion reactions and limits to the fusion cross sections are discussed. Areas of current investigation related to the dynamics of heavy ion reactions are qualitatively described. The application of the rotating liquid drop model to survival of fused systems is discussed. Experimental results which are relevant to the various models are described and interpreted in terms of the limitations predicted by the various models. Predictions as to limiting cross sections for the production of new proton rich nuclei by an evaporation mechanism are also described. (auth)

8549 NUCLEUS-NUCLEUS COLLISIONS AT RELATIVISTIC ENERGIES. Fäldt, G. (University of Lund, Lund, Sweden); Pilkuhn, H.; Schlaile, H.G. Ann. Phys. (N.Y.) 82: No. 2, 326-344 (Feb 1974).

For relativistic beam nuclei up to ^{4}He and medium heavy target nuclei, absorption cross sections and partial production cross sections are computed. Eclipse corrections are found to be essential. For C, N, and O beam nuclei, Coulomb dissociation is computed. (auth)

8550 EQUILIBRIUM CONFIGURATIONS OF ROTATING CHARGED OR GRAVITATING LIQUID MASSES WITH SURFACE TENSION. II. Cohen, S. (Argonne National Laboratory, Argonne, Illinois 60440); Plasil, F.; Swiatecki, W.J. Ann. Phys. (N.Y.) 82: No. 2, 557-596 (Feb 1974).

The equilibrium configurations of rotating charged or gravitating liquid masses with surface tension are investigated. The objective is to discuss in a unified manner configurations of idealized atomic nuclei, rotating liquid drops and rotating idealized astronomical masses. The present paper formulates the problem generally but the applications discussed are mostly to nuclei. These include the estimates of the geometrical characteristics, of the rigid moments of inertia, and of the energies and fission barriers of idealized nuclei throughout the periodic table and with any angular momentum. The existence of super-deformed nuclei, stretched out into cylinderlike configurations by the centrifugal force, is discussed. (auth)

8551 PAULI PRINCIPLE AND THE PION-NUCLEUS INTERACTION. Dover, C.B. (Brookhaven National Laboratory, Upton, New York 11973); Ernst, D.J.; Thaler, R.M. Phys. Rev. Lett. 32: No. 10, 557-560 (11 Mar 1974).

The effect of the Pauli principle on the low-energy pion-nucleus interaction is examined. We find that the Pauli effects do not appreciably alter the estimate of the strength of the p-wave optical potential based on free-space scattering volumes. (auth)

8552 QUASIPARTICLE INTERACTION IN NUCLEAR MATTER. Sjöberg, O. (NORDITA, Copenhagen, Denmark). Ann. Phys. (N.Y.) 78: No. 1, 39-63 (15 May 1973).

Landau's theory for normal Fermi liquids is applied in nuclear matter. The quasi-particle interaction and physical quantities related to this are calculated. We apply a method, previously used by Babu and Brown, where the interaction through the polarization of the medium around a quasiparticle is accounted for. This so-called induced interaction is repulsive and has a tendency to compensate for changes in the (mainly) attractive direct interaction and hence ensures a stability in the total interaction. Another advantage is that the Pauli principle is automatically satisfied. We calculate the direct interaction within the framework of the Brueckner-Bethe theory using the Reid soft-core potential for the bare nucleon-nucleon interaction. For the quasiparticle effective mass m^*, the symmetry energy β and the compression modulus K values of 0.77 m, 25.6 MeV and 184 MeV, respectively, were obtained. (auth)

8553 UNSTABLE STATES PRODUCED IN MULTIPARTICLE REACTIONS. Coester, F. (Argonne National Laboratory, Argonne, Illinois 60439); Schlessinger, L. Ann. Phys. (N.Y.) 78: No. 1, 90-131 (15 May 1973).

Normalized wavefunctions for unstable-particle states are constructed to meet the following physically plausible specifications. The wavefunctions of such states should enter into the theoretical production cross section in the same manner as the bound-state wavefunctions of stable particles. The cross section for the production of an unstable particle should be equal to the breakup cross section integrated over the resonance minus the background. For this purpose the multiparticle reaction cross section is brought into a form such that final-state resonances and interference corrections can be exhibited explicitly. The present theory is limited to unstable particles that decay into one or several two-body channels. For heuristic purposes, rearrangement and breakup scattering for three simple particles is treated numerically. For two particles interacting via a local potential, the wavefunction of the unstable state and the scattering phase shifts are computed with a simple algebraic technique. In order to treat complex multiparticle systems, we extend the resonance theory of simple two-particle systems to resonances in multiparticle two-body channels. (auth)

8554 LIMITATION TO COMPLETE FUSION DURING A COLLISION BETWEEN TWO COMPLEX NUCLEI. Galin, J.; Guerreau, D.; Lefort, M.; Tarrago, X. (Chimie Nucléaire, Institut Physique Nucléaire, BP No. 1, 91406-Orsay, France). Phys. Rev. C 9: No. 3, 1018-1024 (Mar 1974).

Experimental results on the limits observed for complete fusion between heavy nuclei are discussed. It is shown that there is no critical angular momentum independent of the bombarding energy and of the entrance channel. Excitation energy and total angular momentum of the compound system do not appear as good parameters for determining the complete fusion cross section. All the available results can be presented in terms of a critical distance of approach R_{cr}. Such a distance is obtained when the kinetic energy of incoming nucleons equals the interaction potential and is related to the nuclear-matter density of both nuclei. For very heavy partners, a fusion barrier occurs, in addition to the interaction barrier. (auth)

8555 CLASSICAL DESCRIPTION OF THE DEUTERON D-STATE EFFECTS IN SUB-COULOMB (d, p) REACTIONS. Knutson, L.D.; Stephenson, E.J.; Haeberli, W. (University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. Lett. 32: No. 12, 690-694 (25 Mar 1974).

The effects of the deuteron D state on sub-Coulomb (d, p) reactions are explained in terms of a simple physical model. The model, which is based on a classical description of the reaction, makes it possible to understand the observed D-state effects for ^{208}Pb(d, p)^{209}Pb at 9 MeV. (auth)

8556 REGGE POLES AND FORWARD-ANGLE ANOMALIES IN TRANSFER REACTIONS. Fuller, R.C. (Institut für Theoretische Physik der Universität Heidelberg, Heidelberg, Germany); Dragun, O. Phys. Rev. Lett. 32: No. 11, 617-620 (18 Mar 1974).

We use Regge-pole states for the distorted waves in a transfer reaction and compare the results with data showing the forward-angle anomaly. (auth)

8557 OPTICAL MODEL WITH ANGULAR-MOMENTUM-DEPENDENT ABSORPTION, EXCHANGE OF TWO NUCLEONS, AND THE SCATTERING OF ^{16}O ON ^{18}O NEAR THE COULOMB BARRIER. Gelbke, C.K. (Max-Planck-Institut für Kernphysik, Heidelberg, Germany); Block, R.; Richter, A. Phys. Rev. C 9: No. 3, 852-863 (Mar 1974).

The properties of the optical model with angular-momentum-dependent absorption are studied mainly using the scattering of ^{16}O on ^{18}O for energies near the Coulomb barrier. The results have been compared to two-nucleon transfer predictions. The L-dependent form factor has been taken as $f(L) = [1 + \exp\{(L-L_c)/\Delta L_c\}]^{-1}$. The following have been found: (1) There exists an approximate continuous ambiguity concerning the parameters L_c and ΔL_c which implies a simplification with respect to practical calculations. (2) The L cutoff in the imaginary potential produces an L staggering of the reflection coefficients similar to the one by the exchange model. (3) Both models yield a different energy dependence of the L staggering, since the oscillations of the reflection coefficients are, in the

L-dependent optical model, connected with size resonances; in the case of exchange, however, with the symmetry of the reaction and the bound-state wave function of the exchanged particle. (auth)

8558 PARAMETRIZATION OF THE $^1S_0$ TWO NUCLEON TRANSITION MATRIX. Sauer, P.U. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02 139, U.S.A.). Ann. Phys. (N.Y.) 80: No. 2, 242-283 (Oct 1973).

The $^1S_0$ two-nucleon transition matrix T is constructed from the symmetric part σ of its half-shell elements. The on-shell component of σ is given by the phase shift, while a wide class of parametrizations is suggested for the off-shell part. Restrictions on the off-shell part of σ arising from the short range and the proper one-pion-exchange tail of the nucleon-nucleon interaction are investigated. Using σ in the $^1S_0$ and the Reid soft-core potential in the other partial waves, the binding energy per particle in nuclear matter and ^{16}O and the ^{18}O shell-model spectrum are computed. The sensitivity of these nuclear-structure results is tested with respect to (i) smooth off-shell changes in σ, (ii) various assumptions on the high-energy phase shift, (iii) the charge dependence of the phase shift, and (iv) experimental uncertainties in the phase shift. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 6915, 8171, and 8505.

8559 (AEC-tr-7471, pp 111-118) MICRODOSIMETRIC FUNCTIONS OF NEUTRONS AND X RADIATION. Videnskii, V. G.; Pitkevich, V. A.; Farnakeev, V. V. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1974. Translated from Radiobiologiya; 13: No. 3, 412-418(1973).

The theoretical dose versus effect curves were calculated for neutrons with an energy of 14 MeV and x radiation with a maximum energy of 200 keV on the basis of the model of one sensitive column and the Rossi concept of the threshold specific energy. The microdosimetric functions F(Z, D) obtained by the Monte-Carlo method and those of characteristic functions from the experimental spectra of the specific energy, were used in the calculations. (tr-auth)

8560 (COO-3274-13, pp 65-72) POSITRON DIFFUSION IN He GAS. Kim, J. S.; Lee, Y. K.; Madansky, L. [nd].

In nuclear moments and nuclear structure. Annual progress report, June 1, 1973–April 30, 1974.

8561 (ORNL-TM-4530) CALCULATIONS RELATED TO THE APPLICATION OF SILICON DETECTORS IN PION RADIOBIOLOGY. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 73p. Dep. NTIS $6.75.

Calculations have been made of the pulse-height spectrum and energy deposition in silicon detectors of various thicknesses (10, 50, 300, 1000, and 3000 microns) placed in a large region of π^--mesons stopping in tissue. The contribution of π^- captures within the detectors is determined, and the energy deposition in the detector is compared to the actual energy deposition in the tissue with the detector removed. A method for inferring the energy deposition in the tissue by various types of particles from the pulse-height spectra of the thin detectors is discussed and evaluated. (auth)

8562 RECONSTRUCTING INTERIOR HEAD TISSUE FROM X-RAY TRANSMISSIONS. Shepp, L. A.; Logan, B. F. (Bell Telephone Labs., Inc., Murray Hill, NJ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 228-236(Feb 1974).

From 20th nuclear science symposium and 5th nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Several algorithms were proposed for reconstructing the variable attenuation coefficients of tissues inside the skull from x-ray transmission measurements. It is shown that a simulated head section is accurately reconstructed by a modification, which is both fast and simple, of a previously studied algorithm. The possibility of using the algorithm to perform absolute measurements of the attenuation coefficient at points interior to the skull is high. (auth)

8563 MONTE CARLO METHOD FOR CALCULATION OF THE DISTRIBUTION OF IONIZATION LOSSES. Ispirian, K. A.; Margarian, A. T.; Zverev, A. M. (Yerevan Physics Inst., USSR). Nucl. Instrum. Methods; 117: No. 1, 125-129(1974).

A Monte Carlo method for calculation of the distribution of the ionization losses of charged particles passing through thin layers of matter is suggested. The distributions of the energy losses obtained as the result of the calculations is compared with the existing experimental data. The method suggested is especially useful in the case of very thin gas proportional chambers. (auth)

8564 LOW-VELOCITY PROJECTILE-Z^3 EFFECT ON COMPOSITE TARGET: MEAN EXCITATION ENERGIES DERIVED FROM STOPPING POWER MEASUREMENTS. Porter, L. E.; Shepard, C. L. (Univ. of Montana, Missoula). Nucl. Instrum. Methods; 117: No. 1, 1-4(1974).

Previous Bethe–Bloch formula fits to several composite target stopping powers have indicated deviations from Bragg's additivity rule in derived mean excitation energies. Inclusion of low-velocity stopping-power dependence on the projectile-Z^3 alters these results in that the experiment-based mean excitation energies are considerably increased. (1 table) (auth)

8565 DOSIMETRIC STUDIES ON BOARD THE ORBITAL SPACE STATION SALYUT. Red'ko, V. I.; Kozlova, S. B.; Markelov, V. V.; Stepanov, A. S.; Chernykh, I. V. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 3-6(1974). (In Russian).

Dosimetric measurements of cosmic radiation onboard the orbital station "Salyut" carried out with an apparatus equipped with a telescope and two semiconductor detectors are summarized. The apparatus recorded fluxes of charged particles in several energy ranges and measured the linear energy transfer of these particles. The apparatus also included a tissue-equivalent ionization chamber to assay the absorbed dose. According to the experimental data, the dose rate of the absorbed dose was 11 mrad/day, the dose rate of the equivalent dose was 13.4 mrem/day and the mean quality coefficient was 1.2. High energy protons made the principal contribution into the dose (E_p > 140 Mev). This suggests that the distribution of the dose field within the station was more or less uniform. (auth)

8566 INFLUENCE OF INHOMOGENEITY OF THE BEAM ON THE IMAGE QUALITY AND RADIATION DOSE. Drexler, G.; Nahrstedt, U.; Widemann, L. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Munich, Ger.). Roentgenpraxis; 26: No. 7, 160-167(1973). (In German).

With a Ge-(Li) detector, spectra of an x-ray tube beam coming from the focal spot were measured in steps of 2.4° from the center to the cathode-anode side. Also, the radiation dose distribution in the image plane was determined with an ionization chamber without a phantom and behind a human body phantom. The results obtained show that the radiation dose at the anode side field edge is lower than at the cathode side. (GE)

8567 RELATIVISTIC COMPTON SCATTERING BY THE DISCRETE ORDINATES METHOD. Stephan, B. G. (Air Force Weapons Lab., Kirtland AFB, NM); Bridgman, C. J. Nucl. Sci. Eng.; 54: No. 2, 101-115(Jun 1974).

The numerical representation of the scattering kernel for x-ray scattering from a relativistic Maxwellian distribution of electrons was determined in a multigroup discrete S_n treatment of the equation of radiative transfer. An ordinary four-term Legendre polynomial expansion of the scattering kernel was used in the study. Ten sets of 134-group-averaged Wien-weighted cross-section coefficients were calculated for electron temperatures between 0.5 and 20 keV, with photon energies between 0.05 and 400 keV. The first Legendre coefficients satisfy conservation and detailed balance at equilibrium neglecting induced effects. These 134-group cross sections were then collapsed to 10-, 20-, and 40-group cross-section sets for use in parametric transmission studies using a discrete S_n transport code. These studies involved the transmission of a source of x rays through a thin slab of free electrons, varying the source and electron temperatures, the angular behavior of the source, the number of energy groups, the degree of angular quadrature, and the degree of kernel expansion. Steady-state transmission studies in which the source and electron temperatures were equal showed that the kernel is adequately represented by a two-term Legendre polynomial expansion. In optically thin regions, an S_2 angular quadrature is sufficient for near-isotropic sources, while S_{16} or higher quadratures are necessary for highly anisotropic sources. Steady-state transmission studies in which the source temperature did not equal the electron temperature, but in which the cross sections were deliberately weighted by an equilibrium photon distribution, indicated that for 20-energy-group models, for example, the ratio of source temperature to electron-distribution temperature must lie in the interval $0.8 \leq T/T_e \leq 1.8$ if spectral errors are to be limited to 5% or less. (7 figures, 2 tables) (auth)

8568 TRACK-CORE RADIUS OF CHARGED PARTICLES AT RELATIVISTIC SPEED IN CONDENSED MEDIA. Mozumder, A. (Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 60: No. 3, 1145-1148 (1 Feb 1974).

A practical procedure is described to determine the core-size of tracks of charged particles of relativistic speed penetrating a condensed medium. It is based on equating the energy flow outwards at the maximum impact parameter obtained from Fermi's theory to the neglected part of stopping-power arising from Bohr's application of the principle of adiabatic invariance. The core size so obtained increases with the speed of the impinging particle approaching a finite limit at the speed of light (about 132 Å for liquid water). The direct energy transfer from the charged particles at distances greater than the core-radius arising from Cherenkov radiation and molecular excitation has been estimated and shown to be negligible in most cases. (auth)

8569 TESTS OF BRAGG RULE FOR ENERGY LOSS OF ^{4}He IONS IN SOLID COMPOUNDS. Baglin, J.E.E.; Ziegler, J.F. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Appl. Phys. 45: No. 3, 1413-1415 (Mar 1974).

We have measured energy loss cross sections for 2000-keV ^{4}He ions in a number of elements and in their solid compounds. Observed compound values were compared with those predicted by linear

combination of elemental values by using Bragg's rule. Within an experimental uncertainty of ~2%, we report agreement in each case for RhSi, $HfSi_2$, SiO_2, Al_2O_3, Si_3N_4, AlN, W_2N_3, SiC (3C, 6H, and polycrystalline forms), and for melamine and adenine. (auth)

8570 BINARY-ENCOUNTER STOPPING CROSS SECTIONS. I. BASIC THEORY AND CALCULATIONS FOR HELIUM IN HYDROGEN. Harberger, J.H. (Mission Research Corporation, Santa Barbara, California 93102); Johnson, R.E.; Boring, J.W. Phys. Rev. A 9: No. 3, 1161-1171 (Mar 1974).

A model to describe the slowing down of fast-moving heavy particles in matter owing to inelastic collisions is devised using the binary-encounter approximation, and stopping cross sections are calculated specifically for helium in hydrogen. In performing the calculations, each incident-beam charge-state component is treated separately, and the results are combined using the best available experimental information on the equilibrium charge-state fractions. The results both for the partial stopping cross sections of the individual charge-state components and the total stopping cross section of the equilibrium mixture are compared as a function of incident energy with the results of various experiments and with other theories. The calculated total stopping cross section is in reasonable agreement with experiment over a rather wide energy range and is superior at energies below 1 MeV to the results of the Bethe theory, but discrepancies exist between calculated and experimentally determined partial stopping cross sections. These discrepancies are discussed and possible explanations for them are suggested. (auth)

8571 BINARY-ENCOUNTER STOPPING CROSS SECTIONS. II. CALCULATIONS FOR HELIUM IN MULTIELECTRON ATOMS, TARGET Z DEPENDENCE. Harberger, J.H. (Mission Research Corporation, Santa Barbara, California 93102); Johnson, R.E.; Boring, J.W. Phys. Rev. A 9: No. 3, 1172-1181 (Mar 1974).

A previously developed model which describes the slowing down of energetic heavy charged particles in matter owing to electronic collisions is generalized to multielectron target atoms. The model utilizes the binary-encounter approximation to describe the slowing-down collisions and explicitly takes into account the equilibrium charge-state composition of the incident ion beam. Extensive calculations of the electronic stopping cross sections of atomic targets from hydrogen to krypton for incident helium are made using the model and the results are presented as a function of incident energy between 0.1 and 10 MeV for selected targets and as a function of target atomic number for various incident energies. Agreement with experiment is fairly good for light target elements, but the calculated results seriously overestimate measured cross sections for the heavy transition elements at large energies. Possible explanations of this discrepancy are discussed and comparisons are made with various other theories. (auth)

8572 AVERAGE ENERGY EXPENDED PER ION PAIR IN LIQUID ARGON. Miyajima, M.; Takahashi, T.; Konno, S.; Hamada, T. (The Institute of Physical and Chemical Research, Wako-shi, Saitama, Japan); Kubota, S.; Shibamura, H.; Doke, T. Phys. Rev. A 9: No. 3, 1438-1443 (Mar 1974).

The measurement of the W value, the average energy expended per ion pair, in liquid argon for internal conversion electrons emitted from ^{207}Bi, is carried out by the electron-pulse method. Comparing with the W value (26.09 eV) for α particles in a gas mixtures of argon (95%) and methane (5%), the W value in liquid argon is determined to be $23.6^{+0.3}_{-0.3}$ eV. This value is clearly smaller than that in gaseous argon (26.4 eV). Such a reduction of W value in liquid argon can be explained by assuming the existence of the conduction band in liquid argon as in solid argon. Under this assumption, the W value in liquid argon is estimated by applying the energy-balance method, which was used for the rare gases by Platzman. The calculated value thus obtained is in good agreement with the experimental result. Following the same method, the W values for liquid krypton and liquid xenon are also estimated. (auth)

Radiation Source Calibration and Standardization

8573 GAMMA-RAY STANDARDS. Kern, J. (Univ. of Fribourg, Switzerland). pp 345-366 of Charged-Particle-Induced Radiative Capture. Vienna; International Atomic Energy Agency (1974).

From proceedings on charged-particle-induced radiative capture; Vienna, Austria (9 Oct 1972). See STI/PUB-365; CONF-7210117-.

Gamma-ray standards which are used for the calibration of Ge(Li) detectors are reviewed. A critical analysis is presented of the available reference standards: W K_{α_1} x-rays, the ^{198}Au 411-keV transition, and m_0c^2 (annihilation radiation). It is seen that the presently accepted energies are consistent within about 10 ppM. γ rays which have been calibrated with special precision directly against one of the two above-mentioned reference standards are defined as primary standards; only data obtained with iron-free magnetic spectrometers or crystal spectrometers qualify for this designation. A survey of the most precise results is performed. There seems to be a systematic discrepancy between the data of Chalk River and those obtained with crystal spectrometers. Since the former results are of proven consistency over a fairly large energy range, the Chalk River set of primary standards for energies over 280 keV is adopted. The errors quoted by the authors are not always unambiguous, and this subject is discussed in a separate section. Secondary standards have been obtained from the primary standards by several methods, which are presented. Special attention is given to the consistency requirement in setting up series of standard lines. Such consistency should result in a better agreement for (true) energy combinations. A short compilation of recent data on some widely used isotopes is presented. The problem of high-energy standards ($E_\gamma > 2$ MeV) is discussed. In this energy range, ^{56}Co has emerged as the most frequently used radioactive source for both energy and intensity calibrations; a compilation of recent results is given. The general question of intensity calibration is the subject of a special section. Finally, an outlook on the current developments, which will contribute to important improvements in the accuracy of energy standards, is given. (11 tables, 62 references) (auth)

Shielding Calculations and Experiments

Refer also to abstracts 7496, 7539, 8356, and 8700.

PHYSICS (THEORETICAL)

General

Refer also to abstract 8550.

8574 (CONF-740219-1) CURVE FITTING AND THE TRANSMISSION INTEGRAL: WARNINGS AND SUGGESTIONS. Shenoy, G. K.; Friedt, J. M.; Maletta, H.; Ruby, S. L. (Argonne National Lab., Ill. (USA)). 1974. 30p. Dep. NTIS $4.50.

From ninth symposium on Moessbauer effect methodology; Chicago, Illinois, USA (Feb 1974).

The dangers of the thin approximation for the analysis of the partially resolved spectra are considered. Some awareness of partially resolved spectra is presented for a variety of physical and chemical problems. Also the analysis of some actual data is discussed using the convolution procedures. (JFP)

8575 DYNAMIC SCALING LAWS AND EPSILON-EXPANSION IN BOSE SYSTEMS. Suzuki, M.; Igarashi, G. (Tokyo Univ.). Phys. Lett.; 47A: No. 5, 361-362(22 Apr 1974).

Dynamic scaling laws in Bose systems are studied up to ϵ^2, using ϵ-expansion techniques. New values of dynamic critical exponents are obtained in order ϵ^2; the index of a characteristic frequency is given by $z = 2 + (4 \log 2 - 1)\eta + O(\epsilon^3)$. (auth)

8576 EQUIVALENT ANGULAR MOMENTUM OPERATORS FOR SECOND QUANTIZED OPERATORS. Stevens, K. W. H. (Univ. of Nottingham, Eng.). Phys. Lett.; 47A: No. 5, 401-403 (22 Apr 1974).

Formulas useful for replacing second quantized operators by angular momentum operators are derived and commented on in the light of recent results on exchange interactions. (auth)

8577 SCATTERING THEORY IN A TIME-DEPENDENT EXTERNAL FIELD. I. General Theory. Prugovecki, E. (Univ. of Toronto); Tip, A. J. Phys., A (London); 7: No. 5, 572-585(21 Mar 1974).

A general framework is set up for the description of quantum-mechanical scattering processes for the case that both the free hamiltonian $H_0(t) = H_0 + H_1(t)$ and the full hamiltonian $H(t) = H_0(t) + V$ are time-dependent. In particular the existence of the various evolution operators is considered and the wave operators $\Omega_\pm(s)$, which now depend on the initial time s, are defined. The consequences of a periodic time dependence are studied and for $H_1(t)$ of the type $H_1(t) = H_1 \cos(\omega t + \delta)$ it is shown that for $|\omega| \to \infty$ the frequency-dependent wave operators converge to the wave operators which pertain to the case that $H_1(t)$ is absent. (auth)

8578 MODIFIED HAMILTON-SCHWINGER ACTION PRINCIPLE. Shaharir, M. Z. (La Trobe Univ., Bundoora, Australia). J. Phys., A (London); 7: No. 5, 553-562(21 Mar 1974).

The c-number variation in the quantum-mechanical action principle of Schwinger is extended to a q-number variation which uses an action integral analogous to the classical modified Hamilton action integral. An explicit realization of the admissible q-number variation for the Hamiltonian operator, H, given by $[H(q,p,t) = \frac{1}{2}p_i g^{ik}(q)p_k + \frac{1}{2}\{A^j(q), p_j\} + W(q,t)]$ is discussed in terms of Gauteaux variation. The action principle yields the correct Hamilton-Heisenberg equations, and a relation between the Lagrangian L and the Hamiltonian H. It is also shown that while the fundamental commutation relation is successfully derived by Schwinger in his c-number variational principle, the same argument cannot be used in the present q-number variation. A new method of quantization is suggested. (auth)

8579 HARD CORE AS A PSEUDOMETRIC. Miglietta, F. (Univ., Pavia, Italy). Lett. Nuovo Cim.; 9: No. 17, 685-689(27 Apr 1974).

A different approach to the problem of N particles with hard-core interaction is proposed, which introduces a pseudometric into a suitable Hilbert space of states of the system. (LBS)

8580 CHARACTERIZATION OF OBSERVABLES IN QUANTUM MECHANICS BY SOME PROPERTIES OF THEIR EXPECTED VALUES. Maczynski, M. J. (Technical Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 22: No. 2, 135-138(Feb 1974).

It is shown that a real valued function t: S → R defined on the unit sphere S of a Hilbert space H is the expected value function of a unique bounded observable if and only if the following conditions hold: $\|x+y\|^2 t(x+y/\|x+y\|) + \|x-y\|^2 t(x-y/\|x-y\|) = 2\|x\|^2 t(x/\|x\|) + 2\|y\|^2 t(y/\|y\|)$ for all x, y∈H, x, y≠ 0, x ≠ ±y; $t(cx) = t(x)$ for all x∈S and all complex numbers c with $|c| = 1$; t is bounded on S. A generalization of this theorem for unbounded observables is also given. (auth)

8581 LOCAL COMMUTATIVITY OF QUANTIZED SCALAR AND VECTOR FIELDS. Horvath, Z. (Roland Eoetvoes Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 34: No. 4, 281-287(1973).

The connection between the locality of the interpolating and asymptotic fields is studied in case of scalar and vector particles. (auth)

8582 REMARK ON THE TRANSITION-OPERATOR BOSON. Okubo, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. C 9: No. 3, 1188-1191 (Mar 1974).

The transition-operator boson introduced by Dreizler and Klein has been analyzed in detail, and the exact expression for angular momentum operators in terms of the boson has been obtained. The method is found to be applicable only in the asymptotic limit of the large nuclear number. Its relation to another representation due to Holstein and Primakoff has also been investigated. (auth)

Quantum Field Theories

Refer also to abstracts 8032, 8183, 8203, 8286, 8507, and 8606.

8583 LOCAL LAGRANGIAN QUANTUM FIELD THEORY OF ELECTRIC AND MAGNETIC CHARGES OF SPIN-ZERO MESONS. Deo, B. B.; Singh, L. P. (Utkal Univ., Bhubaneswar, India). Indian J. Phys.; 47: No. 11, 650-659(Nov 1973).

A local Lagrangian field theory of spin zero mesons carrying both electric and magnetic charges. The quantization of $(e_m g_n - e_n g_m)$ as integral multiples of 4π is obtained as a condition of integrability of infinitesimal Pioncaré-Lie algebra to finite Poincaré group. Canonical commutation relations, energy momentum tensor and Feynman rules are obtained by usual techniques of Lagrangian field theory. (auth)

8584 SOLVABLE QUANTUM-FIELD MODEL OF THE LEE TYPE WITH BROKEN SU(2) SYMMETRY. Gulii, V. N.; Skripnik, V. A. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 19: No. 4, 926-929(Apr 1974). (In Russian).

A solvable quantum-field model of the Lee type with broken SU(2) symmetry is proposed. Based on the field renormalization a dynamic sum rule is obtained connecting the observable coupling constants and masses of "baryons" N and V. A preliminary comparison is made of this sum rule with available phenomenological sum rules for the real models in the quantum field theory. (auth)

8585 GLOBAL SOLUTIONS OF NONLINEAR RELATIVISTIC WAVE EQUATIONS FOR THE SCALAR QUANTUM FIELD. Raczka, R. (Inst. for Nuclear Research, Warsaw). Nuovo Cim.; 21A: No. 2, 329-350(21 May 1974).

A new method for reducing nonlinear relativistic quantum field equations to classical equations is presented. Then, in terms of the results for classical equations, the solutions for a scalar quantum field are found and their properties analyzed. (auth)

8586 SOLUBLE MODEL OF A SINGLE COMPONENT FERMION INTERACTING WITH A VECTOR MESON. Hagen, C.R. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Ann. Phys. (N.Y.) 81: No. 1, 67-79 (Nov 1973).

A model is formulated in two dimensional spacetime in which a massive vector meson is coupled to only the upper or the lower component of the usual two component fermion field operator. This condition implies a unique (nonconserved) $V \pm A$ form for the current, a result which is equivalent to the statement that the current is either self-dual or anti-self-dual. The Green's functions of the model are computed using the device of the external source. A significant result which emerges is the fact that the renormalized meson mass is not a polynomial form in the coupling constant, a situation which has not previously occurred in any of the known soluble field theories. Although there is no limit of this model in which one can obtain the Thirring model, it is shown that a particular solution of the latter can be obtained provided that one considers only configurations in which all fermion excitations are moving to the left or all are moving to the right. (auth)

8587 SIMPLIFIED BETHE-SALPETER EQUATION FOR POSITRONIUM. Feldman, G.; Fulton, T.; Townsend, J. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218). Ann. Phys. (N.Y.) 82: No. 2, 501-534 (Feb 1974).

The Bethe-Salpeter equation for a fermion-antifermion system, coupled by photons, is considered in the Feynman gauge. The kernel is that resulting from exchange of a single photon. The usual reduction of

the sixteen B-S spinor amplitudes in terms of tensors leads to 16 coupled integro-differential equations. By straightforward application of charge conjugation-, parity-, and Lorentz-invariance, the system of coupled equations is reduced to ones involving no more than eight and as few as three scalar structure functions for the various parity, charge conjugation, and total angular momentum states. The results hold for arbitrary coupling strength. As a check of the equations obtained, a perturbation theory is carried out for the Coulomb interaction. It leads to effective potentials in agreement with those obtained previously to order $m\alpha^4$ for positronium. (auth)

8588 APPROXIMATION METHODS IN THE CONTEXT OF THE BOUND-STATE BETHE-SALPETER EQUATION. Ungerer, H. (Institut für Theoretische Physik, Universität Tübingen, D-74 Tübingen, Auf der Morgenstelle 14, Germany). Ann. Phys. (N.Y.) 82: No. 2, 459-481 (Feb 1974).

Numerical approximation schemes of the Wick-rotated scalar Bethe-Salpeter equation are discussed for general local potentials with special emphasis on mesh-point methods. Convergence properties are obtained by considering the analytic properties of the kernel. To this end, the four-dimensional partial wave equations are formulated in a new representation-independent way. The close relationship of variational and mesh-point methods is demonstrated and the difficulties which arise if singular potentials are introduced are discussed. For marginal singular potentials those difficulties are overcome in a new way by redefining the corresponding two-particle Green's function. Numerical examples for this case are given. (auth)

8589 SHORT-DISTANCE BEHAVIOR OF QUANTUM ELECTRODYNAMICS AND THE CALLAN-SYMANZIK EQUATION FOR THE PHOTON PROPAGATOR. de Rafael, E. (Institute for Advanced Study, Princeton, N.J.); Rosner, J.L. Ann. Phys. (N.Y.) 82: No. 2, 369-406 (Feb 1974).

The short-distance behavior of the photon propagator is discussed within the context of the corresponding Callan-Symanzik equation. The Callan-Symanzik function $\beta(\alpha)$ is calculated in perturbation theory up to sixth order. We find $\beta(\alpha) = (2/3)(\alpha/\pi)+(1/2)(\alpha/\pi)^2-(121/144)(\alpha/\pi)^3+O[(\alpha/\pi)^4]$. The simplicity of this result is to be contrasted with a corresponding perturbation theory calculation of the Gell-Mann-Low function $\psi(z)$, whose sixth-order coefficient contains the transcendental $\zeta(3)$ (the Riemann zeta function of argument three). A mechanism of cancellations in the calculation of $\beta(\alpha)$ has been found, and we prove its validity to all orders in perturbation theory. (auth)

8590 RELATIVISTIC WAVEFUNCTION AND FORM FACTORS OF THE BOUND SYSTEM. Faustov, R.N. (Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, Head Post Office P. O. Box 79, Moscow, USSR). Ann. Phys. (N.Y.) 78: No. 1, 176-189 (15 May 1973).

An explicitly relativistically invariant three-dimensional formulation of the quasi-potential method of Logunov and Tavkhelidze for the system of two particles with arbitrary spins and masses is given. This formalism is used to consider the matrix elements of local operators between bound states (the form factors of the bound system). The transformation law of the three-dimensional wavefunctions in the transition from the center of mass system to an arbitrary reference frame is obtained. (auth)

8591 ON THE RENORMALIZATION METHOD: A DIFFERENT OUTLOOK, AND THE ENERGY-MOMENTUM TENSOR IN THE $g\phi^4$ THEORY. Poggio, E.C. (Department of Physics, Columbia University, New York, N. Y. 10027). Ann. Phys. (N.Y.) 81: No. 2, 481-518 (Dec 1973).

An alternate method of renormalizing a quartic self-interacting boson theory has been developed. We find that one can obtain finite renormalized expressions for the perturbation theory contributions to the Green's function without carrying out limiting procedures. As a consequence of the analysis, one is able to renormalize explicitly the field energy-momentum tensor to all orders. There exists a one-parameter family of renormalized tensors. The method will allow for a simple determination of the asymptotic "zero-mass" theory. (auth)

8592 MULTIPLE TIME SCALES AND THE ϕ^4 MODEL OF QUANTUM FIELD THEORY. Varga, B.B.; Aks, S.Q. (University of Illinois, Chicago, Illinois 60680). J. Math. Phys. (N.Y.) 15: No. 2, 149-154 (Feb 1974).

Multiple time scales perturbation theory is applied to the weakly nonlinear ϕ^4 quantum field theory model. The multiple time scales perturbation equations are solved to lowest order, leading to the removal of secular and quasisecular terms from the standard perturbative solution. This removal occurs in a manner similar to that developed in a previous quasisecular perturbative approach which focused on small energy denominators. The multiple time scales approach provides a better rationale for the quasisecular perturbation theory, as well as providing a systematic method which can be extended to higher orders in the coupling constant. It leads to the natural introduction of a first-order renormalized Hamiltonian, which is a well-defined self-adjoint operator on a certain Hilbert space of physical states. This renormalized Hamiltonian is a direct sum of Schrödinger Hamiltonians on N-particle subspaces, which describe the interactions of pairs of particles via a nonlocal potential. (auth)

8593 MASSIVE GAUGE FIELD IN SOURCE THEORY. I. Finkelstein, R.; Kvitky, J. (Department of Physics, University of California, Los Angeles, California 90024). Ann. Phys. (N.Y.) 80: No. 2, 441-462 (Oct 1973).

The vacuum polarization is calculated for a massive gauge field according to the methods of source theory. The spectral integral turns out to be convergent and the numerical coefficient, which is $(1/3)(e^2/4\pi^2)$ in spinor electrodynamics, is here $(3f/16)(g^2/4\pi^2)$ where f depends on the group and f=1 for SU(2). (auth)

8594 PREQUANTIZATION OF CHARGE. Śniatycki, J. (Department of Mathematics, Statistics, and Computing Science, The University of Calgary, Calgary, Alberta, Canada). J. Math. Phys. (N.Y.) 15: No. 5, 619-620 (May 1974).

It is shown that a necessary and sufficient condition for quantization of relativistic dynamics of a particle with charge e moving in an external electromagnetic field F is that $(e/2\pi)F$ should define an integral de Rham cohomology class on the space-time manifold. (auth)

Gravitation and General Relativity

Refer also to abstracts 7691, 7692, 7818, and 8258.

8595 LIMITATIONS IN THE THEORY OF RELATIVITY. Kar, K. C. (Inst. of Theoretical Physics, Calcutta). Indian J. Theor. Phys.; 21: No. 4, 135-136(Dec 1973).

An extension of relativity theory to the acoustical world is briefly considered. (WDM)

8596 ABSORPTION OF GRAVITY AND THE SEELIGER-YUKAWA POTENTIAL. Treder, H. J. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Astron. Nachr.; 294: No. 5, 193-199(1973). (In German).

Consideration of a "potential-like" coupling between the gravitational potential and the matter tensor in the reference tetrad theory. For dust-like matter (without pressure and stress) with a mass density greater than zero a screening of gravity by the gravitating masses themselves is found to result from this coupling formula in the case of a quasi-Newtonian gravitational potential. This screening is approximately described by a gravitational potential of Seeliger-Yukawa type. It is shown that in cosmology this absorption of gravitation leads to another effective gravitational radius of the universe, which satisfies the condition for an Einstein universe. (IAA)

8597 EINSTEIN GRAVITATIONAL EQUATIONS DEDUCED RIGOROUSLY BY POSTULATING SOME RELATIVISTIC VERSIONS OF THE POISSON EQUATIONS. Part II. Bressan, A. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 53: 280-287(1972). (In Italian).

The gravitational equations are deduced by a relativistic substitution in the Poisson equation that is justifiable in a direct and natural fashion. (tr-auth)

8598 EQUATIONS OF THE EXTERNAL PROBLEM OF N GRAVITATING BODIES WITH ALLOWANCE FOR THE DEVIATION OF THE ARGUMENT IN GENERAL RELATIVITY THEORY. Pisarenko, V. G. (Inst. of Mathematics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; 35: 899-905(Oct 1973). (In Ukrainian).

The equations of the external problem of N gravitating moderately relativistic bodies are derived with allowance for the time lag of the interaction forces in general relativity theory. The equations obtained are shown to extend Newton's law of universal gravitation to cover the requirements of the relativistic theory of gravitation. They describe the motion of N bodies in relativistic celestial mechanics. (IAA)

8599 GRAVITATION THEORY. Thorne, K. S. (California Inst. of Tech., Pasadena). pp 300-324 of Physics 50 Years Later. Brown, S. C. (Ed.). Washington, DC; National Academy of Sciences (1973).

The discussion covers experimental tests in general relativity, black holes, other gravitational phenomena, and space-time singularities. (JFP)

8600 HOW COMMUTATORS OF CONSTRAINTS REFLECT THE SPACETIME STRUCTURE. Teitelboim, C. (Princeton Univ., NJ). Ann. Phys. (N.Y.); 79: No. 2, 542-557(Aug 1973).

The structure constants of the "algebra" of constraints of a parametrized field theory are derived by a simple geometrical argument based exclusively on the path independence of the dynamical evolution; the change in the canonical variables during the

evolution from a given initial surface to a given final surface must be independent of the particular sequence of intermediate surface used in the actual evaluation of this change. The requirement of path independence also implies that the theory will propagate consistently only initial data such that the Hamiltonian vanishes. The vanishing of the Hamiltonian arises because the metric of the surface is a canonical variable rather than a c-number. It is not assumed the constraints can be solved to express four of the momenta in terms of the remaining canonical variables. It is shown that the signature of space-time can be read off from the commutator of two Hamiltonian constraints at different points. The analysis applies equally well irrespective of whether the space-time is a prescribed Riemannian background or whether it is determined by the theory itself as in general relativity. In the former case the structure of the commutators imposes consistency conditions for a theory in which states are defined on arbitrary spacelike surfaces; whereas, in the latter case it provides the conditions for the existence of space-time—"embeddability" conditions which ensure that the evolution of a three-geometry can be viewed as the "motion" of a three-dimensional cut in a four-dimensional space-time of hyperbolic signature. (auth)

8601 CAUSTICS IN TREDER'S GRAVITATION THEORY AND THE COSMOLOGICAL SINGULARITY. von Borzeskowski, H. H. Astrop. Nachr.; 294: No. 5, 207-212(1973). (In German).

Consideration of the conditions under which the solutions of Treder's tetrad theory of gravitation possess caustics. Some comments are made on the problem of proving general singularity theorems and the related problem of characterizing singularities within the framework of Treder's gravitation equations. The results obtained, in particular those pertaining to certain properties of caustics, are compared with the corresponding results for the Einstein equations. (JFP)

8602 WAVE TAILS AND NONSPHERICAL PERTURBATIONS OF RELATIVISTIC GRAVITATIONAL COLLAPSE. Patashinskii, A. Z. (Inst. of Nuclear Physics, Novosibirsk, USSR); Pinus, V. K.; Kharkov, A. A. Lett. Nuovo Cim.; 9: No. 17, 701-703(27 Apr 1974).

Formulas are presented to describe the wave tails and the problem of the behavior of nonspherical perturbations during gravitational collapse. (LBS)

8603 f-GRAVITY AND THE MASSES OF ELEMENTARY PARTICLES. Sivaram, C.; Sinha, K. P. (Indian Inst. of Science, Bangalore). Lett. Nuovo Cim.; 9: No. 17, 704-706(27 Apr 1974).

It was previously demonstrated that, if general relativity were to play some role in the structure of elementary particles, the massive strong-gravity field (mediated by f-mesons) having a different coupling constant G_f must be invoked, rather than Einstein's massless gravity field (mediated by massless gravitons) having the Newtonian constant G_n. The possibility of replacing G_n by the gravitational constant G_f for f-gravity is explored. The meson and baryon mass are illustrated. (LBS)

8604 OPTICAL SCALARS OF CONFORMAL SPACES IN THE GENERAL THEORY OF RELATIVITY. Kolbovskii, Yu. Ya. (Yaroslavl Technological Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 31-34(1974). (In Russian).

The main purpose of this study is to consider the dependence between optical scalars of conformal spaces. Expressions are obtained and investigated that connect among each other the optical scalars (extension, revolution, displacement) of isotropic congruences and of conformal spaces. (SJR)

8605 INERTIAL FRAME OF REFERENCE IN KERR SPACE. Semenov, V. P. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 57-62 (1974). (In Russian).

In a gravitational field created by a uniformly rotating charged ring there is constructed a frame of reference which is an analog of an inertial frame of reference in plane space. Expressions are obtained for the energy included in a sphere of radius r and for the total energy in this frame of reference. The results are compared with results obtained by other investigators. (tr-auth)

8606 GRAVITATIONAL RADIATION OF ISLAND SYSTEMS HAVING AN ELECTROMAGNETIC FIELD. Semenov, V. P. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 62-64(1974). (In Russian).

This study investigates the gravitational radiation of a system of limited sources in the presence of an electromagnetic field. A class of reference systems are introduced that are analogs of inertial systems in plane space—on the basis of criteria proposed by I. M. Dozmorov. Expressions are obtained for the total energy of these systems and for the gravitational radiation flux. (tr-auth)

8607 TETRADS AND THE GRAVITATIONAL-INERTIAL FIELD. Marsh, G. E. Aust. J. Phys.; 27: No. 1, 131-133(Feb 1974).

The tetrad formulation of general relativity allows a nontensorial decomposition of the gravitational field into two components which have been thought to represent the permanent and inertial parts. It is shown that this division does not hold for arbitrary motions in a flat space-time, and therefore cannot be expected to hold in more general spaces. (auth)

8608 INTRODUCTION TO GENERAL RELATIVITY. Sexl, R. (Univ., Vienna). pp 331-371 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

The discussion of general relativity covers field equations and experimental tests, gravitational waves, the use of exterior forms in Riemannian geometry, and gravitational collapse, Kruscal space, and the Kerr metric. (JFP)

8609 NONPOLYNOMIAL LAGRANGIANS, INFINITIES, AND GRAVITY THEORY. Salam, A. (International Centre for Theoretical Physics, Trieste, Italy). pp 386-422 of Developments in High-Energy Physics. Gatto, R. (ed.). New York; Academic Press, Inc. (1972).

From proceedings of the international school of physics "Enrico Fermi"; Varenna, Italy (2 Aug 1971). See CONF-710858-.

The discussion covers analytic regularization methods, their applicability to nonpolynomial Lagrangians and finite computation of renormalization constants in such theories; the effects of including quantized tensor gravity with the electrodynamics of leptons—i.e., the finite and gauge-invariant computation of the electron self-charge and self-mass in the quantum theorists version of curved space and time. Also covered is the speculative suggestion that F mesons couple to the hadronic stress tensor in the same nonpolynomial manner as Einstein's gravitons do to leptons and the possibility of using this nonpolynomiality to regularize renormalization constants in strong interaction physics. (JFP)

8610 ON THE STABILITY OF FLAT SPACE. Choquet-Bruhat, Y. (Laboratoire de Mécanique Relativiste, Université de Paris VI, Paris, France); Deser, S. Ann. Phys. (N.Y.) 81: No. 1, 165-178 (Nov 1973).

It is shown that: (1) there exists, near flat space, a neighborhood of nonsingular asymptotically flat weak field solutions of the initial value equations of General Relativity; the solutions have physically appropriate generality; and (2) this neighborhood is complete and flat space is stable; every geometry representing a weak perturbation and satisfying the varied constraints is tangent to the space of solutions. (auth)

8611 NEW APPROACH TO RELATIVITY AND GRAVITATION. Yilmaz, H. (Perception Technology Corporation, 1017 Main Street, Winchester, Massachusetts 01890). Ann. Phys. (N.Y.) 81: No. 1, 179-200 (Nov 1973).

A theory of gravitation, where the stress-energy tensor of the gravitational field is part of the source term of the geometric curvatures, is presented. The theory predicts correctly all the Newtonian and post-Newtonian effects of gravity currently considered as crucial. For extremely strong and nonstatic fields, such as are presumed to exist in quasars and exploding stars, new predictions differing from those of the conventional theory are implied. In the correspondence limit of special relativity the theory recovers the conservation of energy-momentum properly and seems to represent a more satisfactory extension of special theory of relativity. (auth)

8612 ON THE STABILITY OF HOMOGENEOUS, SPHERICALLY SYMMETRIC, CHARGED FLUIDS IN RELATIVITY. Stettner, R. (Department of Physics, Montana State University, Bozeman, Montana 59715). Ann. Phys. (N.Y.) 80: No. 1, 212-227 (Sept 1973).

A normal mode, stability analysis is applied to a spherically symmetric fluid system which contains a constant surface charge. The stability of the system is analyzed for the situation in which the electromagnetic mass is only a small fraction of the total mass and also for the situation in which the electromagnetic mass is the total gravitational mass. This latter situation corresponds to that of a Poincaré-Lorentz fluid electron. (auth)

8613 SPINOR CALCULUS IN FIVE-DIMENSIONAL RELATIVITY. Leibowitz, E. (Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario, Canada). J. Math. Phys. (N.Y.) 15: No. 3, 306-312 (Mar 1974).

A consistent spinor calculus is developed within the framework of five-dimensional relativity. The formalism is manifestly five-covariant, and in special coordinate systems and special spin frames it reduces to a familiar spinor formalism in curved space-time. The five-dimensional formulation is free of the difficulties involving the coupling of the electromagnetic field, which characterize the four-dimensional approach to spinor calculus. Some theorems and useful identities in the five-dimensional spinor calculus are proved. (auth)

8614 FIVE-DIMENSIONAL APPROACH TO THE NEUTRINO AND ELECTRON THEORIES. Leibowitz, E. (Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario, Canada). J. Math. Phys. (N.Y.) 15: No. 3, 313-316 (Mar 1974).

The theories of the neutrino and the electron are studies from a five-dimensional point of view. The concept of periodic 5-spinors is examined, and the formalism of five-dimensional spinor calculus is applied to the manipulations of spinor equations. It is shown that the five-dimensional approach reproduces the results of the familiar four-dimensional approach in a unified and coherent manner. Furthermore, the present approach predicts in a natural way the correct coupling to the electromagnetic field, without ad hoc assumptions. (auth)

8615 EXACT SOLUTIONS OF EINSTEIN-CONFORMAL SCALAR EQUATIONS. Bekenstein, J.D. (Center for Relativity Theory, University of Texas at Austin, Austin, Texas 78712). Ann. Phys. (N.Y.) 82: No. 2, 535-547 (Feb 1974).

The massless scalar field which satisfies a conformally invariant equation is in some respects more interesting than the ordinary one. Unfortunately, few, if any, exact solutions of Einstein's equations for a conformal scalar stress-energy have appeared previously. Here we present a theorem by means of which one can generate two Einstein-conformal scalar solutions from a single Einstein-ordinary scalar solution (of which many are known). As an example we show how to obtain Weyl-like solutions with a conformal scalar field. We obtain and analyze in some detail two families of spherically symmetric static Einstein-conformal scalar solutions. We also exhibit a family of static spherically symmetric Einstein-Maxwell-conformal scalar solutions (parametrized by both electric and scalar charge), which have black-hole geometries but are not genuine black holes. Finally, we present all the Robertson-Walker cosmological models which contain both incoherent radiation and a homogeneous conformal scalar field. One class of these represents open universes which bounce and never pass through a singular state; they circumvent the "singularity theorems" by violating the energy condition. (auth)

8616 ON THE CONSTANT OF GRAVITATION. Krat, V. A.; Gerlovin, I. L. (The Pulkovo Astronomical Observatory, Leningrad, USSR). Astrophys. Space. Sci.; 26: No. 2, 521-522(Feb 1974).

A value for the gravitational constant G is obtained using the equations of the new fundamental field theory (FFT). The result agrees with other theoretical predictions and seems to be a serious argument in favor of the new FFT. It can be used in new cosmological theories. (auth)

8617 BEHAVIOR OF ZERO REST-MASS FIELDS INCLUDING GRAVITATION IN THE VICINITY OF ZEROS. Audretsch, J. (Queen Elizabeth College, University of London, Campden Hill, London W. 8). Ann. Phys. (N.Y.) 78: No. 1, 284-296 (15 May 1973).

For free nonradiation zero rest-mass fields, as for example the nonnull Maxwell and the Weyl tensor fields in vacuum, a uniform treatment of the behavior of the principal null vectors in the vicinity of boundary zeros is given. It is shown that a boundary zero of a field is a singular point of at least one of its principal null vectors. In the special case of a Maxwell field for which the Poynting three-vector vanishes for a certain observer-field, a boundary zero of the Maxwell field is a singular point of the corresponding electric and magnetic fields. The results are valid in flat and curved spacetimes independently of whether the zero rest-mass fields act as source of the spacetime curvature or not. (auth)

8618 CONFORMAL SPINOR FIELDS IN GENERAL RELATIVITY. Maia, M.D. (Universidade de Brasília, Departamento de Matemática, 70000 Brasília, Brasil). J. Math. Phys. (N.Y.) 15: No. 4, 420-425 (Apr 1974).

A spinor field which is covariant under the group of conformal motions in general relativity is defined. These spinor fields extend the concept of isospinors to the cases where conformal motions take place and coincide with Penrose's twistors in the case of flat space-time. It is found that only certain special conformal spinor fields lead to physical entities. The example of Kruskal's conformal spinors is studied. (auth)

8619 NONRADIATIVE ALGEBRAICALLY SPECIAL SPACE-TIMES. Trim, D.W. (Department of Applied Mathematics, The University of Manitoba, Winnipeg, Manitoba, Canada); Wainwright, J. J. Math. Phys. (N.Y.) 15: No. 5, 535-546 (May 1974).

A recently characterized class of (in general nonvacuum) algebraically special space-times with twisting rays is studied. The Weyl tensor satisfies the peeling-off property along the repeated principal null congruence, and the Ricci tensor exhibits an equally simple asymptotic behavior, which is in fact compatible (via the Einstein field equations) with the presence of a suitably restricted electromagnetic or neutrino field. If the gravitational and source fields are nonradiative, the above asymptotic behavior is restricted. In this case we explicitly solve the Einstein vacuum field equations, the Einstein-Maxwell equations and the Einstein-Weyl (combined gravitational-neutrino) equations. The solutions obtained are related to the known algebraically special solutions of these equations. (auth)

8620 THE GENERAL SOLUTION TO EINSTEIN-MAXWELL EQUATIONS WITH PLANE SYMMETRY. Letelier, P.S. (Instituto de Física, Universidad Católica de Chile, Casilla 114-D, Santiago, Chile); Tabensky, R.R. J. Math. Phys. (N.Y.) 15: No. 5, 594-595 (May 1974).

The general solution to Einstein-Maxwell equations with plane symmetry is obtained. This solution has an extra Killing vector ξ^a not assumed apriori. The solution may be classified in two classes depending on the sign of an integration constant. The first class depends only on the time; ξ^a is spacelike. In the second class ξ^a is spacelike, lightlike, and timelike in different regions like Schwarzschild's metric. (auth)

8621 THE GRAVITATIONAL SEARCHLIGHT EFFECT FROM SYNCHROTRON RADIATION IN THE SCHWARZSCHILD GEOMETRY. Hughes, H.G. III (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Ann. Phys. (N.Y.) 80: No. 2, 463-478 (Oct 1973).

Gravitational synchrotron radiation is studied using the techniques of geometrical optics. It is found that the geometry of the Schwarzschild black hole creates a rotating searchlight effect, even for a source particle which radiates only during an infinitesimally brief interval of coordinate time. The period of rotation of the searchlight is shown to provide a measurement of the mass of the blackhole, since the period T is related to the mass M by $T=2\pi 27^{1/2}$ M for the Schwarzschild geometry and by $T=4\pi M$ for the extreme (a=M) Kerr geometry. (auth)

8622 LOCAL OBSERVATIONS OF GEODESICS IN THE EXTENDED KERR MANIFOLD. St. John, R.H.; Finley III, J.D. (Department of Physics and Astronomy, The University of New Mexico, Albuquerque, New Mexico 87131). J. Math. Phys. (N.Y.) 15: No. 2, 147-148 (Feb 1974).

Geodesics along the axis of symmetry in Carter's extension of the Kerr metric are divided into two types by the sign of the constant of the motion associated with the timelike Killing vector, and it is shown that this also divides them as to their place of origin on the manifold, which contains infinitely many copies of two different spaces which are flat at $r=\pm\infty$. It is shown that geodesics cannot cross from one space to the other, but that a trajectory with properly applied acceleration can cross over. (auth)

8623 THE GENERAL EXACT SOLUTION OF THE EQUATION OF GEODESICS OF THE GENERAL EXACT HOMOGENEOUS PLANE GRAVITATIONAL WAVE. Ebner, D.W. (Lehrstuhl für Theoretische Physik der Universität Konstanz, 775 Konstanz, Germany). J. Math. Phys. (N.Y.) 15: No. 2, 166-171 (Feb 1974).

The general exact solution of the equation of geodesics for the general exact plane homogeneous gravitational wave is given by solving the vacuum field equations for the line element $ds^2 = A(u)dx^2 + B(u)dy^2 + 2C(u)dxdy + dz^2 - dt^2$, with $u = (z - t)/2^{1/2}$ of these waves. The subclass of the exact plane sandwich waves is given explicitly by solving exactly the flatness condition for that line element. The relative energy and momentum transfer on test particles by the sandwich wave is discussed. (auth)

8624 NONRENORMALIZABILITY OF THE QUANTIZED EINSTEIN-MAXWELL SYSTEM. Deser, S.; van Nieuwenhuizen, P. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. Lett. 32: No. 5, 245-247 (4 Feb 1974).

The one-loop divergences of coupled general relativity and electrodynamics cannot be absorbed by renormalization. (auth)

8625 A PROPERTY OF ASYMPTOTICALLY FLAT, STATIC, VACUUM SPACE-TIMES. Hallidy, W. (California State College, California, Pennsylvania 15419). J. Math. Phys. (N.Y.) 15: No. 4, 413-414 (Apr 1974).

It is shown that a necessary condition for stationary, asymptotically flat, vacuum space-times to be static is that the Weyl tensor be electric type to asymptotic order r^{-3}, where r is an affine parameter along null geodesics. (auth)

8626 THE KERR CONGRUENCE. Newman, E.T.; Winicour, J. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). J. Math. Phys. (N.Y.) 15: No. 4, 426-428 (Apr 1974).

We present the special relativistic Kerr congruence from two new points of view. The importance of the Kerr congruence stems from its role in the general relativistic rotating body problem. In the special relativistic limit, it is the simplest twisting generalization of the ordinary light cone. We first show that the Kerr congruence can be obtained from the light cone of complex Minkowski space, which induces a family of oblate spheroids in real Minkowski space. We then show that the rigid rotation of one of these spheroids with constant angular velocity also generates the Kerr congruence by shining comoving flashlights normal to the surface. In fact, the oblate spheroid is the unique surface which generates a shear-free twisting null congruence in this manner. This result has direct generalization to the full Kerr geometry. (auth)

REACTOR TECHNOLOGY AND REGULATION

8627 (NP-19964, pp vp, Paper 9) SITING ON COASTAL AREAS. Shackelford, B. W. (Pacific Gas and Electric Co., San Francisco). 1973.

In seminar on the engineering aspects of siting and operating power plants.

Various aspects of nuclear power plant siting in coastal areas are discussed. Licensing and scheduling associated with the selection and development of a site are reviewed. Siting considerations examined include population density, topography, meteorology, environmental effects of land and water use, geology, and others. (JWR)

8628 (WASH-1309) GUIDANCE ON QUALITY ASSURANCE REQUIREMENTS DURING THE CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. (USAEC, Washington, D. C.). 10 May 1974. 234p. Dep. NTIS $7.60.

Guidelines for the establishment and execution of a quality assurance program for the construction phase of nuclear power plants are presented. The guidelines cover fabrication and manufacturing activities as well as on-site construction. (JWR)

8629 RECENT DEVELOPMENTS OF NUCLEAR ACTIVITIES IN ARGENTINA, MEXICO, AND PERU. Com. Naz. Energ. Nucl., Notiz.; 20: No. 3, 43-46(Mar 1974). (In Italian).

Between late 1973 and early 1974 there have been many major events in the nuclear field in some Latin American countries: the first big power reactor in South America, at the Atucha Power Plant in Argentina, has gone critical on January 13, 1974; a contract was signed in December 1973 between the country's Atomic Commission and the AECL-Italimpianti consortium for the construction of Argentina's second nuclear power plant. This contract, executed early in 1973, is of particular interest to Italy because of the predominant role given to its industry. In December an order was placed for Mexico's second nuclear power plant. Uranium deposits have been found in Peru. (auth)

8630 DEVELOPMENT OF LARGE SCALE OPERATIONAL SIMULATORS FOR POWER PLANT OPERATOR TRAINING. Abbey, G. G. (Singer Simulation Products, Silver Spring, MD). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 975-977(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The use of simulators for training power plant operators is becoming more widespread. A key element in the development of power plant simulators is design data. This predicted data can be categorized as: physical characteristics, general plant physics, and logic and transfer functions. This data must be reduced for use in a simulator. The special requirements of real time training simulation influence the data reduction and application. Later, after actual plant performance is recorded, the simulator programs can be adjusted. Currently, the design data is obtained from numerous sources and the approach on each simulator has varied somewhat. An industry standard as to simulator data requirements is needed. (auth)

8631 ITALIAN NUCLEAR ACTIVITY IN 1972. Battistini, G. (Ingegneria Nucleare, Rome). Ing. Nucl.; 14: No. 2-3, 3-8(1973). (In Italian).

A summary is given of the activity in the nuclear area in 1972. The industrial activity and the electronuclear program are indicated. The research activity included the CIRENE, fast reactor, U enrichment, and CNEN programs, which are briefly described. The restructuring of the CNEN is reported. EURATOM activity is indicated. (JSR)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 8774, 8775, 8791, 8807, 8912, and 8929.

8632 (AECL-4753) STEAM GENERATOR TUBE FAILURES: WORLD EXPERIENCE IN WATER-COOLED NUCLEAR POWER REACTORS DURING 1972. Stevens-Guille, P. D. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Mar 1974. 11p. Dep. NTIS (US Sales Only) $4.00. AECL $0.50.

During 1972, approximately 1 in 3 operating reactors with steam generators incurred tube failures. They predominated near the tube sheet and in the bend region. Various forms of corrosion were the most frequent cause of failure. Eddy current inspection was the preferred method for locating and investigating the cause of failure. Extensive use was made of both mechanical and explosive plugs for repair. As a class, steam generators with Monel-400 tubes had the lowest failure rates and those of Inconel-600, the highest. (auth)

8633 (AED-CONF-74-6-3) COMPARATIVE EVALUATIONS OF BWR CORE MODELS USING POINT KINETICS AND AN AXIALLY RESOLVED MODEL (COSBWR). Bokelmann, R. F. (Kraftwerk Union A. G., Frankfurt am Main (F. R. Germany)). 1974. 5p. (In German). INIS.

From experts meeting of the task groups thermodynamics and fluid dynamics and reactor physics of the KTG on the requirements and present possibilities of predicting physics parameters of thermal and fast power reactors; Karlsruhe, F. R. Germany (29 Jan 1974).

For different transient disturbances without loss of coolant, comparative calculations are analyzed. A good agreement in the time variation of the variables of state is found. While the point kinetic model includes—besides the core model—the outer coolant circuit as well, the one-dimensional model simulates the cooling channel of a boiling water reactor. (INIS)

8634 (CENPD-140) DESCRIPTION OF THE CONTRANS DIGITAL COMPUTER CODE FOR CONTAINMENT PRESSURE AND TEMPERATURE TRANSIENT ANALYSIS. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Apr 1974. 104p.

The CONTRANS digital computer program is described. This code calculates the transient response of the containment and annulus buildings to loss of coolant and main steam line break accidents. The model consists of mass, energy, and volume balances on the containment and annulus buildings. Mass and energy releases to the containment following an accident are code inputs. The model includes active heat sinks such as containment sprays, fan coolers, and shutdown cooling heat exchangers as well as the passive heat sinks such as the containment walls. A variety of wall heat transfer coefficients is available either as internal code functions or code inputs. For long term NSSS energy release after the NSSS has reached pressure equilibrium with the containment, a model of the NSSS is included. This model includes decay heat, RCS and steam generator fluid stored energy and primary and secondary metal-to-coolant heat transfer. The annulus building model includes the containment vessel wall as a heat source and annulus walls as heat sinks. The change in the annulus building volume resulting from thermal and pressure expansion of the containment vessel wall is included. The annulus ventilation system is modeled. The differential equations used in the models are presented. In the simulation the equations are in finite difference form and are numerically integrated in time. Results from CONTRANS for typical loss-of-coolant accidents and main steam line breaks are given. The assumptions and conservatisms made in defining the containment design basis accident are given. 5 references. (auth)

8635 (CONF-730942-P6A-S, pp vp Paper H 3/6) REFERENCE DESIGN OF A PRESTRESSED CONCRETE PRESSURE VESSEL (PCPV) FOR NUCLEAR POWER STATIONS WITH BOILING WATER REACTORS. Bremer, F.; Fuerste, W.; Huber, G.; Meyer, J.; Schafstall, H. G.; Spandick, M. (Fried. Krupp GmbH, Essen). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Information is presented concerning the overall design; the structural design of particular parts as liner and insulation, penetration tubes; structural analysis for PCPV and liner; safety aspects; tests made with liner, insulations, and concrete; and development potential of the PCPV for light water reactors. The economical potential of the PCPV for light water reactors is discussed. (auth)

8636 (CONF-730942-P6B-S, pp vp Paper J 2/5) REFINED CRACKED CONCRETE ANALYSIS OF CONCRETE CONTAINMENT STRUCTURES SUBJECT TO OPERATIONAL AND ENVIRONMENTAL LOADINGS. McGeorge, R.; Swec, F. Jr. (EDS Nuclear Inc., San Francisco). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F.R. Germany (10 Sep 1973).

Recent commerical nuclear power plant containment concepts involve the use of large, reinforced concrete structures to form pressure boundaries. Where these structures are not provided

with an integral steel liner, excessive cracking of the concrete under load could result in loss of the pressure boundary integrity with the risk of overpressurization of other structures. Recently developed finite element procedures for the determination of cracking in reinforced concrete structures, and cracking analyses of an actual, unlined, reinforced concrete containment structure are discussed. Cracking of concrete is a local phenomenon, and considerable detail must be included in any analytical model to obtain sufficiently refined results. This imposes severe limitations on the overall size of structures or components which can be considered. Nuclear containment structures are typically large and structurally complex, and it is therefore usually not practicable to consider the total structure directly in cracking analyses. To overcome this restriction, a two-step procedure was adopted in which linear analyses were performed to obtain the gross response, and nonlinear cracking analyses were performed for selected portions of the structure to evaluate local cracking. Through iteration, compatibility of behavior between the linear and nonlinear analyses was achieved with the gross response being used to extrapolate the local cracking results to predict cracking over the entire structure. The nonlinear cracking analytical procedures discussed involve the coupling of nonlinear finite element techniques with descriptions from recent experimental programs. The influence of reinforcing steel, the effects of steel to concrete bonding, and the gross, nonlinear structural response resulting from concrete cracking are included. The outlined procedures are illustrated using analyses of a cylindrical, reinforced concrete drywell structure for a BWR nuclear plant as an example. A comprehensive set of operational and accident loadings was considered, and particular attention was paid to the evaluation of critical loading sequences in which successive, cumulative damage could lead to degradation of the leakage integrity. Long-duration accident thermal transient events were found to produce significant cracking over the structure, such that a subsequent loss of coolant accident (LOCA) would result in through-cracking, and thus potential leakage paths. The total cracking area, however, was found to be well within the acceptable limits established from by-pass leakage criteria. The cracking details were found to agree well with recently published experimental data, and it is concluded that the state-of-the-art of reinforced concrete analysis has developed to the stage where the structural response of complex structures can be studied, and the details of cracking and crack propagation can be investigated. (auth)

8637 (DEU-73-27) TEST ATOMIC POWER PLANT, KAHL. (Versuchsatomkraftwerk G.m.b.H., Kahl/Main (F. R. Germany)). [nd]. 12p. (In German). INIS.

The test atomic power plant, Kahl, which after 32 months of building, produced electrical energy for the first time, provided practical experience in construction and operation of this type plant and contributed to the further development of nuclear technology and enabled conclusions to be made on the economical realization of later large power plants. The working method of the plant as well as the water-steam cycle of the reactor are described. (GE)

8638 (GEAP-13317-5) BWR BLOWDOWN HEAT TRANSFER. Fifth Quarterly Progress Report, July 1–September 30, 1973. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Sep 1973. Contract AT(04-3)-189. 78p. Dep. NTIS $5.45.

Representative results from the second 16-rod bundle are documented. Comparative results for some parameter variations are also shown. Delivery of the Two-Loop Test Apparatus (TLTA) has been made, and the status of TLTA construction is discussed. Measurement locations of the 49-rod heaters have been selected, and assembly of the heaters has begun. The shakedown plan for the TLTA system has been detailed, and the principal elements are discussed. TLTA internal flow devices have been sized and calibrated in a flow mock-up vessel. 7 references. (auth)

8639 FAILED NUCLEAR REACTOR DETECTION APPARATUS. Jones, C. R. (to Transfer Systems Inc.). US Patent 3,801,441. 2 Apr 1974. Filed date 12 Oct 1971. 10p.

Apparatus for detecting failed or leaking fuel rods in fuel assemblies in a nuclear reactor for power generation are described. A gripper for the fuel assembly is combined with a sampling tube for sucking up a coolant sample after the temperature of the fuel rods has been increased to a level causing increased emission of radioactive residues from a leaking rod. For the BWR, the gripper couples to the fuel assembly channel while in the reactor core in such manner as to isolate in a substantially air-tight manner the fuel assembly. Then an air bubble is introduced depressing the coolant level causing the desired temperature increase. For the PWR, the gripper lifts the fuel assembly into an overhead container to isolate same, and then heat is supplied via auxiliary heaters to raise the temperature of the fuel rods. To increase the sensitivity, the coolant sample is taken from below the upper fuel rod support. (Official Gazette)

8640 NUCLEAR FUEL ASSEMBLY. Fritz, J. R.; Channon, F. R. (to General Electric Co.). US Patent 3,802,995. 9 Apr 1974. Filed date 30 Sep 1971. 10p.

A fuel assembly for a nuclear reactor is described wherein a central cluster of the rods of the assembly are fueled with initial plutonium and wherein a water tube is provided through the cluster to increase the neutron moderation in the region of the plutonium fuel, the water tube also providing axial support for the fuel rod spacers. (Official Gazette)

8641 REACTOR SYSTEM FOR NUCLEAR POWER PLANTS IN THE UNITED KINGDOM. Com. Naz. Energ. Nucl., Notiz.; 20: No. 2, 40-46(Feb 1974). (In Italian).

A review of the present British situation in anticipation of the launching of the new nuclear power program is presented. The opinions of the various leaders of the British nuclear industry concerning the construction of the LWR plants now favored by the CEGB are included. The nuclear power plants now in operation, under construction or planned in the country and the CEGB's estimates of the costs of the various plant types are described. (auth)

8642 DESIGN AND OPERATING EXPERIENCE PROBLEMS WITH CONTROL AND INSTRUMENTATION SYSTEMS. Pilgrim Nuclear Power Station Unit 1. Moriel, A. V. (Boston Edison Co., Plymouth, MA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 937-939(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The Pilgrim Nuclear Power Station is a 690 MWe General Electric designed Boiling Water Reactor. Pilgrim is located forty (40) miles south of Boston at Plymouth, Massachusetts. The instrumentation and control system problems which developed during construction, startup, and operation were of a routine nature. No outstanding problems arose requiring indepth re-evaluation and drastic design changes. The instrumentation and control systems have performed as expected. No false scrams have occurred which could be attributed to design deficiencies. Station Technical Specifications require that extensive routine testing on operating equipment be continuously performed to verify operability and locate and eliminate problems that could negate the required operability of said instrumentation when required. Some of these Instrumentation and Control System problems encountered and the solutions to these problems are discussed. The problems are as follows: I. Duct Temperature Switches–Access, Calibration and Testing; II. Reactor Vessel Water Level Instrumentation Calibration; III. Main Steamline Isolation Valve Logic Testing; IV. Pressure Switch Selection and Application. (auth)

8643 REACTOR COOLANT LEAKAGE DETECTION SYSTEMS. Fairtile, M. B. (Atomic Energy Commission, Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 979-983(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Nuclear reactor containments, especially in the immediate vicinity of the primary system, are generally not accessible to plant personnel for inspection during reactor operation. Some containment systems are operated with nitrogen enriched atmospheres making personnel entry very difficult, for extended periods of operation. There are three barriers between the fissile materials and fission products in the nuclear fuel and the environment. The first barrier is the fuel cladding, the second is the reactor coolant pressure boundary, and the third is the reactor containment. One aspect of the maintenance of the integrity of the reactor coolant pressure boundary, the reactor coolant leakage detection system, is examined. In addition, during the plant lifetime the integrity of the primary system is ensured by many safety systems, administrative controls and various surveillance, test and inspection programs. An "ideal" leakage detection system is presented compared to present systems. A basis for improving present systems to a level closer to the ideal is presented. (auth)

8644 FUEL ASSEMBLIES, GRAPPLES THEREFOR, AND FUEL TRANSPORT APPARATUS FOR NUCLEAR REACTOR POWER PLANT. Jones, C. R. (to Transfer Systems Inc.). US Patent 3,802,996. 9 Apr 1974. Filed date 26 Jan 1972. 14p.

A nuclear fuel assembly is described in which vertically disposed fuel elements are spaced within a housing generally of

a rectanguloid configuration. Each fuel element includes an upper end plug and lower end plug. Vertically spaced support plates are disposed in the housing with suitable openings to receive the upper and lower end plugs of the fuel elements for supporting the fuel elements with the housing. The upper plate is removable from the housing and the lower fuel plug is detachably connected to the lower plate. Other spacer plates are secured to the housing walls to reinforce same. A grapple having lifting plates with pins enters recesses formed in the housing for enabling the housing to be raised. After the fuel assembly is raised by the grapple, leaf spring retainers of the upper plate are dislodged for removing the upper plate from the housing. Now, the fuel elements can be removed selectively and individually from the fuel assembly by a removal tool. Aligned with and disposed above the removal tool is a transfer casing for housing the selectively removed fuel element while the selectively removed fuel element is transported to and from a fuel reprocessor. (Official Gazette)

8645 NUCLEAR FUEL ELEMENT. Penrose, R. T.; Thompson, J. R. (to General Electric Co.). US Patent 3,804,709. 16 Apr 1974. Filed date 15 May 1972. 8p.

A method of protecting the cladding of a nuclear fuel element from internal attack and a nuclear fuel element for use in the core of a nuclear reactor are disclosed. The nuclear fuel element has disposed therein an additive of a barium-containing material and the barium-containing material collects reactive gases through chemical reaction or adsorption at temperatures ranging from room temperature up to fuel element plenum temperatures. The additive is located in the plenum of the fuel element and preferably in the form of particles in a hollow container having a multiplicity of gas permeable openings in one portion of the container with the openings being of a size smaller than the size of the particles. The openings permit gases and liquids entering the plenum to contact the particles. The additive is comprised of elemental barium or a barium alloy containing one or more metals in addition to barium such as aluminum, zirconium, nickel, titanium and combinations thereof. (Official Gazette)

8646 SUMMARY OF OPERATING U. S. POWER REACTORS AS OF MAR. 1, 1974. Nucl. Safety; 15: No. 3, 339-341(1974).

8647 SOME ASPECTS OF WATER CHEMISTRY IN LIGHT WATER REACTOR POWER STATION. Bodmer, M. (Brown, Boveri and Co. Ltd., Baden, Switzerland). Brown Boveri Rev.; 60: No. 9, 417-422(Sep 1973).

Experience gained with nuclear power stations in service has led to new feedwater system arrangements, especially in the case of boiling water reactors. The consequences of forward pumping of h.p. condensate into the feedwater circuit and using a feedwater heater with deaerator in this type of plant are discussed. Mixed beds and precoat filters for condensate polishing are described in conjunction with present-day thermal cycles. A brief survey of the layout and application of a treatment plant for make-up water is given. (auth)

8648 DETERMINATION OF NUCLEAR CHARACTERISTICS OF U/Pu-FUEL ELEMENTS IN LWRs. Hnilica, K.; Holley, H.; Lahner, K. (Nuklear-Ingenieur Service, GmbH, Hanau, Ger.). Atomwirt., Atomtech.; 19: No. 2, 69-71(Feb 1974). (In German).

An exact economical analysis for the follow up device of Pu-containing fuel elements in light water reactors calls for considerable amount of calculation, caused by the various follow up device alternatives. One possibility to determine the nuclear characteristics such as multiplication factor, U-235 concentration, Pu-content and Pu-isotope sector with as little computing effort as possible is the Multi-Variables Synthesis with its method of synthetic experiments. The use of this method is shown for boiling water reactors and pressurized water reactors. Within the pressurized water reactor the Pu-follow up is done exclusively by the all rod concept. Therefore, for all elements, unit cell calculations are done. The use of this method is more problematic for boiling water reactors because the various importance of the individual zones of enrichments has to be taken into account. (GE)

8649 INCREASES IN 1972 OF THE ORDERS FOR ELECTRONUCLEAR POWER PLANTS. Ing. Nucl.; 14: No. 2-3, 9-12(1973). (In Italian).

The electronuclear power ordered, under construction, or in operation in 1972 is outlined by country. The various types of reactors selected are briefly discussed. The medium-term electronuclear programs predicted for development by 1985 are tabulated. (JSR)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 8632, 8634, 8639, 8641, 8643, 8645, 8646, 8648, 8649, 8791, 8794, 8807, 8902, 8911–8913, 8929, 8934, and 8935.

8650 (CONF-730942-P5, pp vp Paper M 8/1) RELIABILITY APPROACH FOR INSPECTION STRATEGY APPLIED TO AN EMERGENCY CORE COOLING SYSTEM. Balfanz, H. P.; Heuser, F. W.; Ullrich, W. (Technische Ueberwachungs-Vereine eV, Cologne). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A reliability analysis is given for a model system of an emergency core cooling system of a pressurized water reactor. In order to show some basic relationships and influences on the system's failure probability the analysis deals only with some main components and subsystems of the emergency core cooling system. Referring to the design basis accident, i.e., the total rupture of a main coolant line, only the low pressure system is considered. The overall system's failure probability is determined by the failure probability per demand, i.e., the unavailability of the system when called on for operation in the emergency case, and the cumulative probability of failure during the subsequent phase of residual heat removal. Detailed calculations have shown that the failure probability per demand is the leading term. Special attention is given to some parameter calculations dealing with the influence of inspection time intervals and repair procedures for different components and subsystems with respect to system's failure behavior. (auth)

8651 (CONF-730942-P6A-S, pp vp Paper E 4/4) VIBRATION-MEASUREMENTS AND ANALYSIS IN NUCLEAR POWER PLANTS. Bastl, W. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Reactor components vibration measurement and analysis are described. Though the starting point of the investigation is the on-load surveillance, it is shown that the interpretation of the on-line signals makes necessary a well planned startup measurement program. This again leads to a deeper understanding of the dynamic phenomena inside the vessel, which is important for the design and the inspection procedure as well. A short survey shows how the vibration is appearing in the various signals, by which techniques it can be measured and analyzed. The power spectra and cross power spectra of the neutron signal and partly of the pressure signal are discussed with respect to results gained at the reactors Trino, Sena and Obrigheim. Typical for these measurements is the well-expressed pendular behavior of the reactor vessel/core barrel-structure as to be seen from the analysis of the neutron flux signal. Special experiments performed at the ECO-reactor show the influence of fuel rod oscillations on the neutron flux. Some recent results obtained by specific analysis of pressure and displacement signals at the Technische Universität München are discussed, which are indicating the sources of hydrodynamic forces and their action on the structure. 7 references. (auth)

8652 (INIS-mf-1079) STUDY OF THE QUANTITATIVE ANALYSIS METHODS OF THE NUCLEAR FUELS WITHIN THE NATIONAL AND IAEA CONTROL AND SAFEGUARDS SYSTEM FOR WWER ENERGY REACTORS. Haraga, C. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 77p. (In Rumanian). INIS.

Thesis.

Various aspects in employing fissionable nuclear materials in nuclear power stations of the WWER type (common water under pressure) are studied from the point of view of the safeguard control, both of the IAEA and of the national one. The paper includes 5 chapters. The historical, political and legal aspects of the fissile material control, the characteristics of the PWR type reactors which are important from the safeguards point of view, the fundamental elements of the national control system, as well as the general criteria that define the efficiency of the fissile material inspections, are presented. The main objectives and characteristics of a National Nuclear Program from the point of view of the safeguards and control system are outlined. The most important elements in determination and evaluation of the nuclear fuel burnup by various methods, which restricts the control within the limits of the reactor stage as against all the other stages of the fuel cycle, are described. (INIS)

8653 (NP-19984, pp vp, Paper 12) POWER PLANT SITING OFFSHORE. Baker, R. A. (Public Service Electric and Gas Co., Newark, NJ). 1973.

In seminar on the engineering aspects of siting and operating power plants.

The offshore siting of large-mounted, breakwater-protected nuclear power plants is discussed. The principal incentives for offshore siting are reviewed. The general design concepts of offshore plants are briefly described and some proposed facilities are mentioned. (JWR)

8654 (WARD-MRP-141) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, July 26, 1973–January 25, 1974. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). 1974. Contract AT(36-1)-Gen-14. 16p. Dep. NTIS $4.00.

Plant Operations and testing of the Shippingport PWR Core 2, Seed 2 continued with all four reactor coolant loops in operation until October 12, 1973 when the plant was shut down for scheduled semi-annual maintenance and testing. The plant was returned to operation with three reactor coolant loops on November 19, 1973. The 1A loop was isolated to permit steam generator inspection and repair of a small primary-to-secondary leak. Total operating time with PWR-2, Seed 2 was increased to approximately 10,122 equivalent full power hours (EFPH) during this period. The first M-160 spent fuel shipment and three Multipurpose Extended Life Blanket Assemblies (MELBA) spent fuel bundles were shipped to the Expended Core Facility (ECF) in Idaho. The remaining three MELBA units were transferred to Bettis for eventual shipment to ECF. The use of Thermoluminescent Dosimetry (TLD) monitors for the Shippingport environmental monitoring program was implemented and technical assistance was provided to the Shippingport Station in the areas of radiation counting instrumentation and the use of containment devices. (auth)

8655 NUCLEAR POWER IN YUGOSLAVIA. Lavrencic, D.; Perilli, M. L.; Sansone, M. M. Com. Naz. Energ. Nucl., Notiz.; 20: No. 3, 32-38(Mar 1974). (In Italian).

A review of the energy picture in Yugoslavia is presented with special reference to the nuclear power program. The main specifications of this plant are presented. The uranium supply picture which is considered adequate to the country's requirements and some information on the country's nuclear research facilities are described. (auth)

8656 ELECTRICAL DESIGN CHANGES AT INDIAN POINT NO. 3 NUCLEAR GENERATING STATION. Szabados, P.; Saya, R. A.; Duggan, P. M. (Consolidated Edison Co., New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 950-956(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The Indian Point No. 3 electrical facility and some of the major electrical modifications made to the original plant design are described. These design changes involved modifications to the offsite power supply system, the plant D. C. system, the diesel fuel oil transfer system and other hardware and circuitry within the "safeguard" system. It should be understood that many of the modifications came about during the later stages of plant construction. This limited the designers freedom in developing feasible solutions to various problems encountered. (auth)

8657 OCONEE NUCLEAR STATION UNIT 1 STARTUP: INSTRUMENTATION AND CONTROL EXPERIENCE. Coley, W. A.; Bradham, O. S. (Duke Power Co., Charlotte, NC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 934-936(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Selected instrumentation and control experience from the startup of Oconee 1, which is an 886 MWe nuclear generating and first-of-a-kind design, is discussed. (auth)

8658 NUCLEAR REACTOR FUEL ROD. Nilson, W. G. (to United Nuclear Corp.). US Patent 3,804,708. 16 Apr 1974. Filed date 24 Nov 1971. 4p.

A nuclear reactor fuel rod is provided with cladding of zirconium alloy which is especially textured in order to reduce axial irradiation growth and to increase end of life ductility. In particular, the cladding is an elongated tube of zirconium alloy wherein the basal poles of the constituent metal crystals are oriented in directions having their principal components in the radial and axial directions. (Official Gazette)

8659 FUEL ASSEMBLY FOR POWER GENERATING NUCLEAR REACTOR. Jones, C. R. (to Transfer Systems Inc.). US Patent 3,801,453. 2 Apr 1974. Filed date 11 Feb 1972. 6p.

A fuel assembly especially adapted for a pressurized water reactor is described. It comprises a support assembly of control element guide tubes, upper and lower end fittings, and grid spacers holding a plurality of fuel rods in vertical parallel relation. The fuel assembly features a removable upper end fitting allowing on-site access to and removal of individual fuel rods, and a novel guide tube construction providing high volume coolant flow through the assembly and allowing ready access of a grapple having laterally, outwardly extending gripping fingers to the assembly for lifting purposes. (Official Gazette)

8660 NOISE MEASUREMENTS AT BEZNAU NUCLEAR POWER STATION. Karrer, H. (Brown, Boveri and Co. Ltd., Baden, Switzerland). Brown Boveri Rev.; 60: No. 9, 423-426(Sep 1973).

Full-load shut-down at Beznau nuclear power station involves exhausting the steam through external valves. In order to comply with the demands stipulated by the client, it was necessary to install a larger exhaust silencer than has ever been built before. (auth)

8661 TEMPERATURE MONITORING IN NUCLEAR POWER STATIONS (TIHANGE). Montmayeur, R. (Etablissements Merlin et Gerin, Grenoble, France). Kerntechnik; 16: No. 1, 25-27 (Jan 1974).

The system of temperature monitoring in the Tihange nuclear power plant comprises 700 measuring points. The temperatures to be monitored are between 0 and 400°C. Three scanners MGS 240 have been installed in order to control the measuring points. 240 is the number of measuring points which can be controlled by one of these scanners. The construction, testing, and application of the scanner are described. (GE)

8662 REGULAR INSPECTION ON NO. 1 NUCLEAR POWER PLANT IN THE KANSAI POWER COMPANY'S MIHAMA POWER STATION. Tanaka, S. (Mitsubishi Heavy Industries, Ltd., Kobe, Japan). Karyoku Hatsuden; 24: No. 3, 258-273(Mar 1973). (In Japanese).

No. 1 nuclear power plant in the Mihama power station, as the first PWR plant in Japan, started its operation in November 1970. The output is 340 MW(e) with steam generating equipment. Its regular inspection continued for two months after shut-down in October 1971. Inspection works carried out and also radiation control involved and future plans are described. Eddy-current flaw detection devices for steam generating tubes and an underwater supersonic flaw detection device for a reactor containment vessel, developed after the regular inspection, are briefly described. The inspection by ultrasonic, liquid penetration and magnetic powder techniques and other visual means was carried out on the reactor containment vessel, and the steam generating equipment. (JA)

8663 NUCLEAR REACTOR FOR THE DISTILLATION OF SEAWATER. Lagowski, J. P. (to United States Atomic Energy Commission). German(FRG) Patent 1,564,976. 25 Jan 1973. 8p. (In German).

The water-cooled reactor has its core at the bottom of a deep shaft which is filled with water, where precautions are taken not to let the part of the container liquid used as cooling medium for the reactor core mix together with the remaining liquid mass in the container. The liquid column above the core is placed so high that its applied static pressure on the cooling liquid prevents the boiling of the cooling liquid at maximum operational temperature. The supplied cooling medium outside the heat exchangers is cooled to such an extent by the seawater that desalination of at least part of the seawater takes place. (GE)

8664 TECHNICAL AND ECONOMIC ASPECTS OF STEAM GENERATION FROM NUCLEAR ENERGY. Guenther, H. (Ludwigshafen am Rhein, Ger.). Chem.-Ing.-Tech.; 46: No. 3, 92-95 (Feb 1974). (In German).

From meeting of the Gesellschaft Deutscher Chemiker energy and electrical heat; Ludwigshafen am Rhein am Rhein, Ger. (4 Oct 1973).

The development of fossil fuel prices favors the application of nuclear energy. Economic prerequisites of an industrial nuclear power plant are a minimum block size of the plant and operation near full capacity. The BASF project taken as example envisages a pressurized water reactor with a thermal capacity of 2,210 MW. The plant is designed for supplying steam at 1,600 t/h and about 410 MW of electricity. A characteristic feature is the requirement that no non-permissible radioactivity levels occur in the process steam. In order to meet this requirement in the event of minor leakages, a tertiary cycle is available which can be put into operation if required. Waste heat boilers and high-pressure generating plants also feed steam into the steam supply networks. In the case

of failure of the nuclear power plant, the high-pressure plant operating at partial capacity is stepped up and rapid start boilers brought into operation. Steam reservoirs are provided for momentary support of the steam supply networks. (GE)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 7285, 8632, 8641, 8646, 8649, 8784, 8785, 8810, 8851, 8900, and 8910.

8665 (CONF-730942-P5, pp vp Paper M 3/2) APPLICATION OF LARGE USER-ORIENTATED SYSTEMS OF PROGRAMS TO THE SOLUTION OF NONLINEAR AND DYNAMIC PROBLEMS. Jezernik, A.; Leech, A.; Whitwam, C. M. (Central Electricity Generating Board, London). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The application of the user-orientated and modular Structural Analysis Systems offers many advantages when solving complex and costly non-linear and dynamics problems and could also have a significant impact on development of new models in the system. For the solution of creep and plasticity problems the CEGB system of structural programs contains at present six different flow rules covering the creep behavior of metals, viscoelastic materials and plastic deformation in two dimensions. Two alternative finite element solution techniques, the direct-band approach and an iterative procedure, are available. In the solution of dynamic problems a modified front solution combined with nodal condensation is used and various finite elements for two and three dimensional solid bodies, plates, beams and pipe structures are available. In general various models and solution techniques are available in various programs in the system, but all programs use a standardized input/output and a common library, to store data and results, on 3330 magnetic disks. The elastic and creep analysis of the stainless steel guide tube, a part of 2 × 660 MW(e) Advanced Gas-cooled Reactor Hartlepool Power Station has been performed. The guide tube with inside diameter 10.25" and thickness 0.16" is assumed to be under external pressure 40 p.s.i.a. and heated to a uniform temperature of 600°C. Material properties for Type 321 steel have been used in the analysis. Time hardening flow rule is assumed and two alternative finite element solution techniques have been applied, direct approach using TESS program and iterative procedure using STAG program. The dynamic behavior of the same guide tube is examined using programs DYSAFE and BERDYNE for natural and forced vibrations. The results are presented and the interaction of design criteria and maximum stresses from both analyses examined. The non-linear and dynamic behavior of a mild steel guide tube with inside diameter 3.75" and thickness 0.18", a part of 585 MW(e) Trawsfynydd Nuclear Power Station under different loading conditions is examined in the same way as the Hartlepool guide tube. Some representative results are shown. In both cases the possibility of failure of the tube during the working life of the power station due to creep collapse, dynamic loading or combined effects is discussed. The solution of some non-linear stress problems including the effects of creep and plasticity of fast reactor components is examined using the improved TESS program. In the presented analyses various models and solution techniques and different finite element types have been used in running a number of programs available in the system. The advantages of the system approach to an engineer-designer solving complex non-linear and dynamics problems are presented from the point of the selection of the optimum model and solution technique, data management, the combined running of various programs and computer economy. The impact of the system approach on further non-linear and dynamic research work is examined and some recent advances in these fields at the Central Electricity Generating Board are discussed. (auth)

8666 (CONF-730942-P6A-S, pp vp Paper H 4/5) THIN-WALLED PRESTRESSED CONCRETE PRESSURE VESSEL FOR HIGH TEMPERATURE REACTORS: EXPERIMENTAL INVESTIGATIONS ON THREE 1:20 SCALE PCPV MODELS AND DESIGN PHILOSOPHY PROPOSAL. Scotto, F. L. (ENEL, Rome). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The basic results of tests performed on the 1:20 PCPV model test announced at the 1st SMIRT Conference and available information on the result that will be ready at the time of the 2nd SMIRT Conference on two additional 1:20 scale confirmatory models identical to the previous one but without penetrations are presented. The triaxial state of stresses in the structure is checked by taking into account the results of triaxial tests carried out by the ENEL Research Laboratory of Niguarda (Milan-Italy) with the method already described at the Rilem Symposium of Cannes (France) Oct. 1972. The models refer to an advanced design of PCPV. A proposal of "design philosophy" of PCPV and the model test data are presented with the aim to support the suggested design criteria. The results of a sophisticated finite element calculation of the referenced 1:20 scale models are checked and compared with the results obtained from the tests. Comments are made regarding the reliability to adopt constant modulus of elasticity and Poisson ratio for elastic calculations (assuming that the model can be considered a design tool in which the actual concrete properties are modelled). (auth)

8667 (GKSS-74-E-7) THERMODYNAMIC ASPECTS OF THE DISCUSSION OF CAPSULE TESTS WITH TEST PIECES FROM INTEGRATED HTR BLOCK ELEMENTS IN THE FRG-2. Penndorf, K.; Schult, F. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1974. 15p. (In German). Dep. NTIS (US Sales Only) $4.00.

Two-dimensional temperature fields from representative sections from integrated HTR block elements are compared with those in samples for irradiation capsules. Evidence is obtained for the possibilities of imitating the stationary HTR conditions in irradiation capsules. (GE)

8668 DEVICE FOR COOLING THE STRUCTURAL MATERIALS OF A REACTOR CORE AND FOR CARRYING OFF THE POST-DISINTEGRATION HEAT. Foerster, S.; Schneider, K. U. Haarmann, K. W. (to Kernforschungsanlage Julich Gesellschaft mit Beschrankter Haftung). US Patent 3,802,994. 9 Apr 1974. Priority date 7 Dec 1971, F. R. Germany. 6p.

A device is described for cooling the structural materials of the core of a gas cooled nuclear reactor and for carrying off the post-disintegration heat occurring after shut down of the reactor. The core is surrounded by a reflector and is within a container of prestressed concrete or the like; the core has an inlet and outlet for the cooling gas. The reflector and container are radially spaced from one another so as to form an annular chamber, which contains cooling gas or solid material suitable for heat transfer. A thermal shield protects that wall of the container which faces the core from heat effects. A radiator is also provided in the annular chamber. Circulation blowers are arranged in chamber means above the core within the container and are in communication with the radiator, the inlet for the cooling gas, and the annular chamber. The chamber means and the amular chamber are selectively opened or closed by valves. (Official Gazette)

8669 NUCLEAR-FUEL ELEMENT. Barthels, H.; Fassbender, J.; Katscher, W. (to Kernforschungsanlage Julich Gesellschaft mit Beschrankter Haftung). US Patent 3,801,450. 2 Apr 1974. Priority date 24 Dec 1970, F.R. Germany. 8p.

A fuel element for a nuclear reactor comprises a hollow structure forming a coolant path and one or more partitions intercepting the coolant flow between the inlet and the outlet, the partitions comprising perforated, aperture or porous supporting walls flanking a porous mass of coated nuclear-fuel particles. (Official Gazette)

8670 NUCLEAR REACTOR. Pettinger, D. S.; Roberts, G. A. (to Nuclear Power Group Ltd.). US Patent 3,804,711. 16 Apr 1974. Filed date 20 Oct 1970. 4p.

A graphite core for a nuclear reactor is described comprising an assembly of graphite blocks arranged vertically in spaced columns. Each block has means for maintaining it in alignment with adjacent blocks of its column. A layer of spacer blocks is supported on top of the core with the individual spacer blocks aligned with the columns. Laterally displaceable wedges in each spacer block are adapted to be displaced laterally to contact directly or indirectly the blocks of adjacent columns with the wedges being disposed in at least one ring around the spacer block. (Official Gazette)

8671 THERMALLY INSULATED PANEL FOR A GAS COOLED NUCLEAR REACTOR. Farfaletti-Casali, F. (to European Atomic Energy Community). US Patent 3,804,712. 16 Apr 1974. Priority date 18 Nov 1969, Luxembourg. 4p.

A thermal insulation panel is described for the interior of a vessel in a gas cooled reactor. A series of metal strips, spaced apart from one another, are bent in a zigzag shape to define between them a plurality of cells. Adjacent metal strips are connected to each other, preferably at places where the distance between the strip is minimal, by metal bridging members. The cells house thermal insulating material which has the same shape as the cells and which is constructed and interconnected with the metal strips to permit thermal expansion of the panel. In one em-

bodiment the insulation includes a plurality of metal insulating sheets while in an alternative embodiment the insulation is made of a fibrous or porous material with a single metal insulating sheet to enclose such material. The metal insulation has one undulation along a diagonal and at least two undulations perpendicular to the one undulation to permit thermal expansion of the panel. (Official Gazette)

8672 MULTIPLE STANDPIPE-CONTROLLED CORE HOLD DOWN MECHANISMS FOR FLUID-COOLED NUCLEAR REACTORS. Walker, A.; Williams, M. R. (to British Nuclear Design and Construction Ltd.). US Patent 3,801,442. 2 Apr 1974. Priority date 8 Apr 1968. United Kingdom of Great Britain and Northern Ireland. 4p.

In a nuclear reactor core each column is maintained in a located position by an upper and lower support member, clearances being provided between the columns to cater for bowing thereof under irradiation conditions. The upper member may be released from its column so that the column may be withdrawn from the reactor pressure vessel. Groups of columns may have their upper support members connected to a standpipe closure plug so that when the latter is withdrawn from its standpipe the group of columns is released. Preferably the dimensions of the columns are such that any bowing occurring under irradiation conditions is accommodated by the clearances. (Official Gazette)

8673 METHOD FOR CHARGE IDENTIFICATION OF THE FUEL ELEMENTS OF A PEBBLE-BED REACTOR OF OPERATING CONDITIONS. Stupp, H. J.; Overhoff, T. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 22: No. 4, 237-241 (1974). (In German).

A method is described to identify under reactor conditions (40 atm He) different charges (≤90) of the highly radioactive fuel elements at the outlet of the pebble-bed-reactor with a period of ≤10 s. This method is based on atomic spectral analysis with laser-excitation. Distinctive marks for the different charges are special elements or their combinations, which are added to the graphite of the fuel-balls. The time needed for analysis is about 150 μs per ball, the consumption of material 5 to 10 μg, corresponding to a crater-depth of approximately 0.01 mm and diameter of ≤0.5 mm, and the concentration of the added elements some 10 ppM. Properties of the balls and the neutron-economy of the reactor are effected just to a negligible extent. (GE)

8674 COST FUNCTIONS FOR HTR-DIRECT-CYCLE COMPONENTS. Schlenker, H. V. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 22: No. 4, 226-235(1974).

A cost analysis is performed to investigate the influence of parameters for components of a power station with a helium-cooled high temperature reactor and with a helium turbine. The selected components are the recuperative heat exchanger, the pre- and intermediate cooler, the cooling tower, the prestressed concrete pressure vessel, the turboset and a section of the helium duct. Parameters are capacity, pressure and temperature, and the data, which are specific for each component. The influences of the main parameters on the costs are given by means of functions. (GE)

8675 ANALYSIS OF MEASUREMENTS OF RATING TILTS ACROSS AGR FUEL CLUSTERS. Bridge, M. J.; Howarth, N. (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc.; 13: No. 2, 193-202(Apr 1974).

Calculations of cross-cluster rating gradients are compared with a series of measurements performed on an experimental reactor simulating most features of a civil advanced gas-cooled reactor at the start of life. All calculations use a heterogeneous reactor code. Novel features are the introduction of a collision probability calculation of the neutron streaming parameters and an expansion of the tilted flux in eigenvectors of the moderator scattering matrix to give a simple method of correcting for thermal spectrum changes. It is shown that by using these methods the cross-cluster gradients may be predicted with a 1 standard deviation error of approximately 10%. (auth)

8676 GAS TURBINE PLANT OPERATED BY NUCLEAR OR FOSSIL FUELS. Schabert, H. P. (to Siemens AG). German (FRG) Patent 1,751,226. 15 Feb 1973. 6p. (In German).

The plant described is characterized in that two of the planned partial current compressors at different temperature levels are attached to the high pressure side of the recuperative heat exchanger and a partial current compressor, with the highest final temperature, is operated by its own driving turbine. A directly cooled nuclear reactor or a fossil heated boiler plant are used as heat source. (GE)

8677 NUCLEAR POWER IN THE UNITED KINGDOM. Moore, R. V. At. Jap.; 17: No. 5, Suppl, 34-43(May 1973).

The course taken up to now in the U. K. in nuclear power generation is reviewed. Emergence of one Company engaged mainly in the development of nuclear reactors and the existing British Nuclear Fuels Ltd. is described. A recent development is the setting-up of two new companies of intra-Europe collaboration concerned with centrifuge development. United Reprocessors Ltd. for fuel reprocessing is also forthcoming. The United Kingdom is one of the few countries not pursuing the light-water reactor route. Magnox nuclear power plants and the following advanced gas-cooled reactors are explained in this connection, on the outstanding economic features for the former and the technological aspects for the latter. Finally, HTR, SGHWR, etc. being developed are examined. (JA)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 8632, 8641, 8649, 8748, and 8795–8797.

8678 (AECL-4771) STEAM GENERATOR RELIABILITY: THE CANADIAN APPROACH. Hodge, R. I.; LeSurf, J. E.; Hilborn, J. W. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Apr 1974. 21p. (CONF-740327-1). Dep. NTIS (US Sales Only) $4.25. AECL $0.50.

From 19th nuclear congress meeting; Rome, Italy (21 Mar 1974).

Operating experience with steam generators in CANDU-PHW (Canada Deuterium Uranium–Pressurized Heavy Water) reactors has been good, particularly in the 2160 MW(e) Pickering station which alone contains about 25% of all tubes in operating water-cooled reactors throughout the world. Various development programs relating both to long-term integrity of steam generators and (as a second line of defense) to maintenance and repair were undertaken in support of the Pickering design. Much of this work has been further extended, to maintain the standards in steam generators currently being designed to new requirements of performance and economy. The program on vibration and fretting is providing a more rational basis for design. Various experiments have provided new data on hydraulic excitation of tubes, and computer programs have been developed to estimate tube response to such excitation. Fretting measurements are being made at levels down to 10^{-3} m/hr. The information from this program is used by manufacturers who now furnish a vibration analysis. The corrosion program is mainly concerned with evaluation of tube materials and specification of water chemistry to avoid pitting and cracking from the secondary side. Monel-400 has performed well in existing reactors and no evidence of localized corrosion has been found. However in later CANDU reactors some boiling will occur in the primary coolant, resulting in higher oxygen concentration. Since this could cause greater general corrosion of Monel-400, with consequent higher radiation fields from the corrosion products, Incoloy-800 with appropriate water treatment is favored for these reactors. Detailed procedures have been developed to locate any tubes which might leak, and an industrial company is now qualified to carry out rapid field repair by explosive plugging. Special eddy current probes have been developed for scanning tubes during a repair so that preventive plugging can be carried out on any deteriorating tubes. (auth)

8679 (BARC/I-195) LOAD TEST OF RAPP END-SHIELD BOGIE WAGON. Kakodkar, A.; Soni, M. L. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 14p. INIS.

The load test of Rajasthan Atomic Power Plant (RAPP) end-shield bogie wagon was conducted at Weapon Equipment Department, Mankhurd, on 26.4.1972. Results of the strain measurements made during the test have been reported. The schematic layout of strain gauge locations has been given. Actual strain values obtained by subtracting the noload-readings from the other readings have been tabulated. Longitudinal strain values vs. various loads have been plotted and their relationship has been found to be linear. The zone of maximum stress has been found to shift to the central straight section of the wagon frames. It has been concluded that the reinforcement is effective and that the wagon is structurally adequate and safe. (INIS)

8680 (CE-BNL-BIB-5) CANDU REACTOR SYSTEM: A BIBLIOGRAPHY. Hitchings, F. A. (comp.). (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1974. 10p. Dep. NTIS (US Sales Only) $4.00.

A selection of forty-nine references is presented on the Candu

reactor system. Short abstracts are included and the period covered is 1967 to February 1974. (UK).

8681 (INIS-mf-971) DEVELOPMENT OF A FUEL ELEMENT FOR HWR (CIRENE PROTOTYPE REACTOR). Boccalari, M.; Gabaglio, M.; Liscia, A.; Sberze, L.; Trittoni, E. (Comitato Nazionale per l'Energia Nucleare, Saluggia (Italy)). Oct 1972. 7p. INIS.

From 2nd Italian-Polish meeting on some chemical, ceramic, and metallurgic aspects of nuclear fuels; Rome, Italy (3 Oct 1972).

Research and work in the field of fuel element manufacturing for the 40 MW(e) Cirene prototype reactor were developed. A pilot plant was set up having the capability of 25 ton/year of UO_2 in assembled bundles. The ceramic section, the canning section, the assembling section and the control section are installed in the pilot plant. The elements produced will be selected at random for irradiation tests. From these experiments it is expected that the final confirmation of the suitability of the proposed fuel design and manufacture procedure will be determined. The confirmation of the data obtained from the previous irradiation test performed in Cirene operating conditions loops is expected. (INIS)

8682 (INIS-mf-977) SURVEY OF QUALITY CONTROL METHODS USED AT LFCEC FOR THE DEVELOPMENT OF CIRENE FUEL ELEMENTS. Gabaglio, M.; Nasi, M. (Comitato Nazionale per l'Energia Nucleare, Saluggia (Italy)). Oct 1972. 10p. INIS.

From 2nd Italian-Polish meeting on some chemical, ceramic, and metallurgic aspects of nuclear fuels; Rome, Italy (3 Oct 1972).

A summary is presented of the procedures used for the characterization and quality control of the fuel elements for use in the Cirene program. A fabrication process and capability to manufacture high quality, fully characterized fuels for the Cirene reactor program is described. The Cirene fuel element consists of eighteen fuel pins. A fuel pin consists of a stack of UO_2 dished pellets sheathed in a Zircaloy-2 cladding tube. Some results obtained during the last process development phase are also presented. (INIS)

8683 PRESSURE TUBE TYPE HEAVY-WATER MODERATED POWER REACTOR WITH BOILING LIGHT WATER COOLANT. Yasukawa, S.; Shinoda, W.; Shindo, R.; Tadokoro, Y.; Seya, T.; Mitake, S.; Arai, T.; Hirano, M.; Sato, S.; Sawai, S. US Patent 3,801,443. 2 Apr 1974. Filed date 26 Jul 1971. 6p.

On the first fuel loading, fuel clusters each being composed of fuel elements with slightly enriched uranium dioxide are inserted in the respective pressure tube of a heavy-water moderated reactor with boiling light-water coolant, and after the second loading, fuel clusters each being composed of fuel elements of natural uranium dioxide mixed with plutonium dioxide which is the by-product fuel obtained from the spent fuel of the firstly loaded slightly enriched uranium dioxide fuel, are inserted in the same respective pressure tubes of a heavy water moderated reactor with boiling light water coolant, the diameter of respective fuel rods being smaller than that of the firstly loaded fuel and the number of the fuel rods in a cluster being the same as that of the firstly loaded fuel cluster. The core structure of the nuclear reactor, except the fuel cladding tube, is not changed throughout the continuous operation of the reactor. When the number of the fuel rods in the respective clusters of the reactor after the second loading is made larger than the number of the first loading fuel rods in the clusters and when the increased number is properly selected, the channel power output of the reactor is increased significantly. (Official Gazette)

8684 MULTIPHASE NUCLEAR FUEL CAVITY REACTORS FOR POWER GENERATION. Pinkel, B.; Gritton, E. C. (Rand Corp., Santa Monica, CA). pp 58-64 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The characteristics and problems of cavity reactors with the fuel in the solid, solid/liquid, solid/liquid/gas, liquid and liquid/gas states are explored analytically in an effort to uncover interesting operational regimes. Operation with the fuel in a thin liquid film on the cavity wall promises continuous fission debris removal and interesting performance (e.g., 2000 MW(t) in a 5 ft radius cavity), but poses problems of container penetration by the fuel and gravity induced fuel flow. These problems are avoided when the fuel film is solid at the expense of power and operational duration. 10 references. (auth)

8685 EVALUATION OF GAS CORE REACTORS WITH MHD CONVERSION FOR CLEAN, ECONOMICAL POWER GENERATION. Williams, J. R. (Georgia Inst. of Tech., Atlanta). pp 65-69 of 2nd Symposium on Uranium Plasmas: research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: Research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Closed cycle nuclear-MHD power plants will require the development of a high temperature gas cooled reactor which can operate economically, reliably, and for long periods of time with an exit temperature in excess of 2500°K. The gaseous core nuclear reactor currently being developed for space propulsion, appears to be ideal for this type of plant. Several studies have shown that a gaseous core reactor power plant utilizing an MHD-steam cycle can have an overall thermal efficiency of 65 percent or higher. A preliminary design of a gaseous core reactor with MHD conversion for electrical power generation has recently been completed. A study of various gaseous core thermal breeder reactor concepts at Georgia Tech predicted breeding ratios as high as 1.13 for reactor configurations similar to the "coaxial flow" rocket reactor under development by NASA. 21 references. (auth)

8686 BALLISTIC PISTON FISSIONING PLASMA EXPERIMENT. Miller, B. E. (Univ. of Florida, Gainesville); Thom, K.; Lalos, G. T. pp 78-82 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The production of fissioning uranium plasma samples such that the fission fragment stopping distance is less than the dimensions of the plasma is approached by using a ballistic piston device for the compression of UF_6. The experimental apparatus is described. At room temperature the gun can be loaded up to 100 torr UF_6 partial pressure, but at compression a thousandfold increase of pressure can be obtained at a particle density in the order of 10^{19}/ccm. In order to understand the effects of fission fragment interactions, the thermodynamics is studied, for a comparison with subsequent in-core measurements involving $^{235}UF_6$. 6 references. (auth)

8687 SOME PROPERTIES OF A FLOWING URANIUM HEXAFLUORIDE SEEDED PLASMA. Wu, J. C.; Williams, J. R.; Hadley, J. C.; Cooper, B. P. (Georgia Inst. of Tech., Atlanta). pp 83-89 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Properties of a subsonic argon plasma stream, with and without small amounts of additives, are measured at pressures of 15 and 30 Torr and enthalpies up to 1.5×10^3 cal/gm using an electrostatic probe. Emphasis is placed on the effect of seeding with UF_6 on the electrical properties of the plasma. This effect is found to be qualitatively similar to that of seeding with SF_6, which is known to be an effective electrophilic compound. Typically, the introduction of UF_6 in the concentration of only $1.13 \times 10^{13}/cm^3$, or 0.025% of n_A, reduces n_e by about 98% (from $1.66 \times 10^{12}/cm^3$). The possible adverse effect due to the depletion of electrons in a gas core reactor–MHD generator system is discussed. In addition, a probe theory which incorporates procedures to account for the presence of negative ions is outlined. The use of electrophilic additives removes the limitation, due to excessive electron current, on the use of electrostatic probes in plasma diagnostics. 17 references. (auth)

8688 URANIUM PLASMA EMISSION COEFFICIENT IN THE VISIBLE AND NEAR U. V. Mack, J. M. Jr.; Usher, J. L.; Schneider, R. T.; Campbell, H. D. (Univ. of Florida, Gainesville). pp 105-109 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Measurements of the specific emission coefficient in the near ultra-violet and visible region of a uranium arc plasma are reported. Spatial unfolding of the intensity profile is used to determine the emission coefficient in the spectral range of 2000 Å to 6000 Å. The uranium partial pressure is estimated to range between 0.001 and 0.01 atmosphere, and the corresponding temperature range is 5000–10,000°K. 6 references. (auth)

8689 GENERATION OF A URANIUM PLASMA AT NEAR GASEOUS CORE REACTOR CONDITIONS. Davis, J. F. III.; Schnitzler, B. G.; Schneider, R. T. (Univ. of Florida, Gainesville). pp 110-116 of 2nd Symposium on Uranium Plasmas:

Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

A constricted sliding spark discharge is used to generate a high density, high temperature uranium plasma. Uranium particle densities up to 10^{20} cm^{-3} are obtained over a temperature range of 30,000°K–50,000°K. The device consists of a capillary discharge channel lined with pressed and sintered UO_2. A 250 joule capacitor bank is discharged into the channel, producing a plasma of 10–20 μsec duration. Spectroscopic observations are made over the spectral range of 1300 Å to 2500 Å. 21 references. (auth)

8690 PROGRESS REPORT: INDUCTION PLASMA SIMULATION OF THE GCNR. Vogel, C. E. (Humphreys Corp., Bow, NH). pp 170–172 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Significant progress has been made in the design, construction and operation of induction coupled devices which simulate the open cycle Gas Core Nuclear Rocket. These devices incorporate solid feed of the plasma forming material (uranium and uranium simulating materials), permeable walls, seeding of the propellant, and transpiration cooled, choked flow nozzles. Operating parameters and performance data of devices employing these design features are discussed. A uranium plasma experiment is included. In addition, operating data of several devices which compare theoretical and actual performance at a variety of powers, pressures, frequencies, and sizes are discussed. 8 references. (auth)

8691 UF_6 PLASMA ENGINE. Kylstra, C. D.; Cooper, J. L. Jr.; Miller, B. E. (Univ. of Florida, Gainesville). pp 283–290 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The concept of a pulsed plasma core reactor enclosed by a cylinder and a piston is a direct analog of a gasoline internal combustion engine. The fuel-working fluid is UF_6–He and the spark plug is an artificial neutron source. The reactor is made critical during the compression stroke, and the neutron flux is allowed to build up to a significant power level before shutdown and the power stroke. Results from nucleonic and energy calculations are presented that show significant power (MW's per cylinder) with high efficiencies (40–50%) at reasonable pressures and temperatures. Problem areas are discussed. 7 references. (auth)

8692 FUTURE VARIANTS ON THE CANDU THEME. Mooradian, A. J. (Atomic Energy of Canada Ltd., Ottawa). Energ. Nucl. (Milan); 21: No. 4, 209–213(Apr 1974).

The future possible variants aimed at improving the performances of the CANDU-PHW (natural uranium fueled, heavy water moderated and cooled) reactors are briefly examined. The role is also underlined that the CANDU-BLW reactors might play, in the near-mid term, for the exploitation of the plutonium produced by the CANDU-PHWs. As for the long term, the possible introduction of the thorium cycle in the CANDU system is considered, which would eliminate any worries as regards fuel supply in the future. Lastly, two very advanced methods currently investigated in a quite preliminary way in Canada are quoted, which should produce, through fusion or spallation reactions respectively, the neutrons for fuel breeding in a thorium fueled CANDU reactor. (auth)

8693 IMPORTANCE OF MATERIAL BUCKLING IN HEAVY WATER PRESSURE TUBE THERMAL REACTORS AND IN LIGHT WATER THERMAL REACTORS. Ertek, C. (Cekmece Nuclear Research Center, Istanbul). Atomkernenergie; 23: No. 1, 54–56 (1974).

The importance of material buckling in heavy water pressure tube thermal reactors and in light water, thermal reactors is emphasized. The reason why $N(D_2O)/N$ (uranium) ratios around a certain number is used in D_2O and CO_2 cooled heavy water pressure tube reactors is briefly discussed. Maximum material buckling values for various moderator to uranium ratios for light water thermal reactors are also indicated to show the "optimum" working conditions. (GE)

Power Reactors, Breeding

Refer also to abstracts 6005, 8649, 8677, 8777, 8790, 8793, 8808, and 8904.

8694 (ANL-RDP-26) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1974. (Argonne National Lab., Ill. (USA)). 26 Apr 1974. Contract W-31-109-eng-38. 165p. AT.

Progress in LMFBR development studies is reported under the following headings: EBR-2; hot fuel examination facility; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; and environmental studies. (JWR)

8695 (CONF-730942-P5, pp vp Paper M 3/3) DYNAMIC ELASTIC–PLASTIC ANALYSIS OF AXISYMMETRIC STRUCTURES BY FINITE ELEMENT METHOD COMPUTER CODE. Nagato, K. (Kawasaki Heavy Industries, Ltd., Tokyo). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The finite element method provides a valuable tool for the analysis of structures subjected to dynamic pressures, which is necessary for the safety design of a Liquid Metal Fast Breeder Reactor (LMFBR). As compared with methods of a linear static analysis, this analysis includes the additional effects such as inertia force, large displacement, and material non-linearity. DANTE is a dynamic elastic-plastic axisymmetric finite element code for this analysis. The equation of motion of elastic-plastic structures follows from the incremental-variable elasticity method given by Marcal, and the static relations by applying d'Alembert's principle: $[M]_{t_n}\{\ddot{\delta}\}_{t_n} + [K]_{t_n}\{\delta\}_{t_n} = \{F\}_{t_n}$. $\{\ddot{\delta}\}_{t_n}$ and $\{\delta\}_{t_n}$ are a displacement vector and an acceleration vector of nodal points at a time t_n. $\{F\}_{t_n}$ is a nodal force vector due to the distributed load and strain at a previous time t_{n-1}. $[M]_{t_n}$ and $[K]_{t_n}$ are a mass matrix and a stiffness matrix at the time t_n. $[M]_{t_n}$, $[K]_{t_n}$ and $\{F\}_{t_n}$ are calculated with the revised geometry at the previous time t_{n-1}, because the large deformation has a significant effect on the loading. Input data of stress-strain behavior are: tabular data of $\bar{\sigma}$ vs. $\bar{\varepsilon}$; or K and $n(\bar{\sigma} = K\bar{\varepsilon}^n)$. $\bar{\sigma}$ and $\bar{\varepsilon}$ are an equivalent stress and an equivalent strain. The stiffness matrix $[K]_{t_n}$ is calculated from the input data and $\bar{\varepsilon}$ at the time t_{n-1} with the Prandtl-Reuss flow rule. The second order simultaneous differential equation is solved by a step-by-step forward recurrence formula, using the following assumption: (1) a constant acceleration during each time increment; or (2) a linearly varying acceleration during each time increment. To keep the computing time to minimum, DANTE is written with the following decisions: (a) to use the simplest element (triangular element with 6 degrees of freedom); and (b) not to use auxiliary memory devices such as MT, Drum etc. (number of elements ≦ 600, number of nodal points ≦ 350, and band width ≦ 23). An example is the calculation of an axisymmetric structure (a tube-sheet and shell with $\rho = 7.8$ gr/cm^3, $K = 62.0$ kg/mm^2, and $n = 0.287$) subjected to a dynamic pressure (148 kg/cm^2 step pulse). It uses the assumption (1), because a calculation with the assumption (2) diverges. The optimum time increment is determined by DYNSHL computer code which calculates the dynamic behavior of thin-walled cylinder subjected to dynamic internal pressure. The comparison of the dynamic behavior of the cylindrical part by DANTE and DYNSHL illustrates a reasonable agreement. (auth)

8696 (CONF-730942-P5, pp vp Paper M 7/1) CORE-WIDE STATISTICAL EVALUATION OF THE EFFECT OF UNCERTAINTIES IN CLAD TEMPERATURE, MATERIAL PROPERTY DATA, AND BURNUP ON THE PROBABILITY OF LMFBR FUEL ROD FAILURE DUE TO CREEP RUPTURE. Atcheson, D. B.; Temme, M. I. (General Electric Co., Sunnyvale, CA). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Proper treatment of the large uncertainties inherent in LMFBR core component design requires development of probabilistic design tools to analyze life-limiting loading mechanisms. One of these tools is a Monte Carlo simulation technique which has been developed to analyze sealed plenum fuel rods subject to fission-gas-induced creep rupture. This Monte Carlo technique avoids the need for simplifying the forms of probability distributions, and is able to correctly simulate the interaction of many random variables by inclusion of all such variables in the analysis. With the use of a biased sampling technique, sufficiently accurate predictions of the number of fission gas pressure-induced failures in the core are obtained in typical calculations for less than $50 ($500 without biasing) on the Honeywell-6000 computer. The application of the biasing technique to core-wide analysis provides a major new capability at a cost which allows routine design use.

The PECS computer code, which employs these techniques, has been applied to study the significance of thermal and nuclear design options and uncertainties in material properties, temperature, dimensions, and burnup. Common "worst rod" analysis has been extended to core-wide analysis by dividing the core into finite regions which are assumed to contain equivalent rods operating under the same environmental conditions. Local variables, such as dimensions, are allowed to vary independently between regions, while global variables (such as creep-rupture strength) remain constant over the core. For each region, probability distributions of time-to-rupture and cumulative damage fraction are determined. This information, along with the number of rods per region, determines a distribution for the number of core-wide failures in the nominal lifetime. At present, the expected value (mean) of this distribution is calculated; the complete distribution will be determined in future analyses. Calculations performed using the new techniques indicate that clad failure probability, and the mean number of core-wide failures, is extremely sensitive to uncertainties in creep-rupture strength and clad temperature. When effective clad wastage is defined to account for changes in material characteristics as well as dimensional changes, reduction of uncertainty in effective wastage also produces a significant effect. The ability of the model to represent systematic core-wide variations in temperature and burnup has been used to analyze the effects of orificing and fuel management options on the expected number of failures in the core. Specifically, the effect of reducing peak burnup and temperature, while the number of rods operating at peak conditions is increased, was investigated. (auth)

8697 (CONF-730942-P6A-S, pp vp Paper E 1/2) MODEL AND CONDITIONS FOR FRAGMENTATION DURING MOLTEN FUEL/COOLANT THERMAL INTERACTIONS. Caldarola, L.; Kastenberg, W. E. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The thermal conditions necessary for fragmentation during molten/fuel coolant interactions to take place, models based on these conditions for describing fragmentation, and the case of molten UO_2/sodium are described. The conditions and proposed model are based on experimental evidence as reported in the open literature. 15 references. (auth)

8698 (EURFNR-1158) FAST REACTOR PROGRAMME. Finite Element Temperature Analysis in Fuel Pins. Slagter, W. (Stichting Reactor Centrum Nederland, Petten). Nov 1973. 28p. (RCN-188). Dep. NTIS (US Sales Only) $4.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

This report deals with an analysis of heat transfer in equilateral triangular fuel rod bundles cooled by a liquid metal in turbulent axial flow. The purpose has been to determine the effect of the presence of supporting points on the temperature distribution in the cladding. The finite element method has been applied to compute the temperature distributions in fuel, gap, cladding and coolant. A computer program called SINT, based on this finite element method, has been developed for steady state temperature calculations using finite elements of triangular shape. It solves two-dimensional heat transfer problems for complex-shaped regions with varying properties and boundary conditions defined by prescribed temperatures, heat fluxes and convective heat transfer. The calculations of temperature fields in fuel pins have been performed for different spacer types, assuming slug flow for the coolant and treating physical properties of the materials and volumetric heat generation in the fuel as constants. (auth)

8699 (GEAP-10028-49) CORE ENGINEERING. Forty-ninth Quarterly Report, November 1973–January 1974. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Feb 1974. Contract AT(04-3)-893. 83p. AT.

This report is the forty-ninth in a series of quarterly progress reports published under the Core Engineering Program. The objective of the work reported here is to provide the engineering design basis for the core of a liquid metal cooled fast breeder reactor. Progress is described for tasks related to fuel rods, fuel rod assemblies, core restraint, and control and blanket assemblies. (auth)

8700 (GEAP-13771-9) NUCLEAR DESIGN AND SHIELDING. Ninth Quarterly Report, October–December 1973. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Jan 1974. Contract AT(04-3)-893. 94p. AT.

Current activities and technical progress for the period October through December 1973, are reported for four subtasks. Subtask A covers the post-analysis of the Demonstration Plant Benchmark Critical Experiments in ZPPR-3 and the technical direction and analysis of similar experiments in ZPPR-4. Subtask B is directed toward the development of calculational methods that can be used at the sites of the demonstration and later LMFBR Plants to determine the reactor power distribution, reactivity and fuel status, and for consideration of alternate fuel and control management schemes. Subtask C is in support of the nuclear data evaluation and testing efforts and methods development for the national LMFBR program. Subtask D progress is reported for the post-measurement analysis of axial shield and radial stainless steel versus B_4C neutron attenuation experiments. (auth)

8701 (NP-19964, pp vp, Paper 2) ROLE OF NUCLEAR POWER IN MEETING FUTURE ENERGY DEMANDS (INCLUDING DISCUSSION OF LIQUID METAL FAST BREEDER REACTOR DEMONSTRATION PROJECT AND ROLE OF BREEDER). Behnke, W. B. (Commonwealth Edison Co., Chicago). 1973.

In seminar on the engineering aspects of siting and operating power plants.

Current outlooks for energy supply and demand are reviewed and the increasing role of nuclear power is pointed out. The importance of the LMFBR in achieving the full potential of nuclear power is discussed. The status of the LMFBR demonstration project is surveyed. (JWR)

8702 CRITICAL HEAT FLUX AND PRESSURE DROP TESTS WITH PARALLEL UPFLOW OF HIGH PRESSURE WATER IN BUNDLES OF TWENTY ¼-INCH RODS. LeTourneau, B. W.; Gavin, M. E.; Green, S. J. (Westinghouse Electric Corp., West Mifflin, PA). Nucl. Sci. Eng.; 54: No. 2, 214-232(Jun 1974).

Critical heat flux and pressure drop tests were run with vertical upflow of water parallel to 20-rod bundles of rods at 1200 to 2000 psia and mass velocities from 0.15×10^6 to 3.0×10^6 lb/(h ft^2). The heated rods were 0.75-in. o.d. × 94-in. heated length, spaced by warts in a 5 × 4 array on a 0.765-in. equilateral-triangular pitch in a rhombic shroud box. Tests were run both with all rods uniformly heated and with a linear-transverse heat-flux distribution, with and without protrusions to minimize the effect of large peripheral channels. (auth)

8703 NUCLEAR REACTOR FUEL ELEMENT. Cayol, A.; Clottes, G. (to Commissariat a l'Energie Atomique). US Patent 3,801,449. 2 Apr 1974. Priority date 22 May 1970, France. 4p.

A fuel element is described which is constituted by a vertically-disposed leak-tight can containing a column of pellets of fissile or fertile material carried by a rigidly fixed bearing member having at least one axial duct essentially comprising an intermediate component which is slidably mounted between the column and the bearing member. Longitudinal grooves are formed in the cylindrical wall of the intermediate component and communicate with radial grooves formed in the flat end faces of the component. (Official Gazette)

8704 FLUX SYNTHESIS CALCULATIONS FOR FAST REACTORS. Adams, C. H.; Stacey, W. M. Jr. (Argonne National Lab., IL). Nucl. Sci. Eng.; 54: No. 2, 201-206(Jun 1974).

A number of calculations have been performed to investigate the use of spatial flux synthesis methods in fast reactor analysis. Guidelines are discussed for choosing appropriate expansion functions. The use of a continuous multichannel synthesis formulation is illustrated by a sodium voiding calculation. (auth)

8705 REMOVABLE TOP SHIELD FOR A NUCLEAR REACTOR CORE. Brandstetter, R.; Robin, M. (to Commissariat a l'Energie Atomique). US Patent 3,801,448. 2 Apr 1974. Priority date 30 Nov 1971, France. 4p.

The removable top shield comprises two rotating shield plugs mounted in eccentric relation for closing the top portion of the reactor vessel and is made up of metallic shielding flasks containing shielding elements and mounted on a frame so as to constitute a cluster unit. The cluster units are supported on flooring elements which are attached respectively to the large shield plug and the small shield plug of the reactor by means of a metallic structure and the flooring being carried on the lateral shields of the reactor core. (Official Gazette)

8706 HELICAL COIL HEAT EXCHANGER. Boardman, C. E.; Germer, J. H. (to United States Atomic Energy Commission). US Patent 3,805,890. 23 Apr 1974. Filed date 12 Dec 1972. 8p.

A heat exchanger is described which is particularly applicable for transferring heat from a reactor-heated primary coolant circuit to a secondary coolant circuit, wherein the secondary coolant flows upward inside helical tubes in a counterflow arrangement with respect to the primary coolant, and the ends of the helical tubes are attached to tube sheets which are accessible from above for inspection and repair, and a method for locating and repairing

leaking conditions. The invention is applicable, for example, as an intermediate heat exchanger in a sodium to sodium system for large liquid metal fast breeder reactors. (Official Gazette)

8707 LMFBR NEUTRON MONITORING SYSTEMS: A REVIEW OF THE STATE-OF-THE-ART. Popper, G. F. (Argonne National Lab., IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 741-749(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The French PHENIX, the British PFR and the West German SNR-300 Prototype Fast Reactor neutron monitoring system concepts are reviewed and compared to U. S. systems. Emphasis is placed on the type of neutron detectors and preamplifier electronics being used. The French Series CFUC and the British Type P7 high temperature (~1050°F) fission counters are described and indicated performance discussed based upon published results. High temperature compensated ionization chambers manufactured in Europe and the U. S. are briefly covered. The European low level flux monitoring preamplifier philosophies are related and compared to present and planned U. S. systems. Major differences are noted and discussed. Recent test results from wide range systems mated with fission counters operating at 725°F in the EBR-II Nuclear Instrument Test Facility (NITF) are presented. The NITF facility is briefly described. (auth)

8708 NEUTRON FLUX MEASUREMENT INSTALLATION FOR LIQUID-COOLED NUCLEAR REACTORS. Culambourg, J.; Marmonier, P.; Naudet, R.; Sauvage, Michel. (to Commissariat a l'Energie Atomique). US Patent 3,802,962. 9 Apr 1974. Priority date 20 Jan 1971, France. 6p.

A stationary neutron detection chamber is placed beneath a reactor vessel which contains the coolant liquid and a reactor core constituted by an array of juxtaposed fuel assemblies designed for vertical insertion. A removable tubular enclosure containing an inert gas has an upper portion located within the reactor core and corresponding in shape to the adjacent fuel assemblies. A cylindrical lower portion of the enclosure extends downward from the core to the immediate vicinity of the reactor vessel wall and in vertically overhead relation to the neutron detector. (Official Gazette)

8709 EXPLORATORY CALCULATIONS FOR A GASEOUS CORE BREEDER REACTOR. Kalifelz, J. M.; Williams, J. R. (Georgia Inst. of Tech., Atlanta). pp 70-71 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Information concerning the basic design parameters of a gaseous core breeder reactor is presented. 15 references. (DCC)

8710 GAS-COOLED FAST BREEDER REACTORS. II. Ackermann, G. Kernenergie; 17: No. 2, 29-33(Feb 1974). (In German).

The review is completed with a discussion of the characteristics of two types of fast breeders: helium breeder with short doubling time and a N_2O_4-cooled breeder with a short doubling time. The properties of the N_2O_3 are discussed in some detail. The characteristics of two variations of the N_2O_4-cooled breeder are tabulated and compared. (JSR)

8711 APPLICATION OF MATHEMATICAL MODELS TO THE ANALYSIS OF FAST TRANSIENT PROCESSES IN LMFBR. Hermansky, B. (Technical Univ., Prague). Kernenergie; 17: No. 2, 53-57(Feb 1974). (In German).

A mathematical model describing transient processes in the Soviet type of LMFBR is introduced. The model is based on one-point nonlinear kinetic equations, linear feedback mechanism, and nonlinear detailed distributed parameters model for heat transfer. For the numerical solution the simple finite-difference scheme is used and a calculational code in FORTRAN IV is adopted. Some examples of calculated power, accumulated energy, and transient temperatures after positive changes in reactivity are given. (auth)

8712 CHARACTERIZATION OF AN ENERGY SOURCE FOR MODELING HYPOTHETICAL CORE DISRUPTIVE ACCIDENTS IN NUCLEAR REACTORS. Cagliostro, D. J. (Stanford Research Inst., Menlo Park, CA); Florence, A. L.; Abrahamson, G. R.; Nagumo, G. Nucl. Eng. Des.; 27: No. 1, 94-105(1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The experimental methods for and results of determining the expansion characteristics of the detonation products of an energy source that simulates the pressure–volume change relationships for sodium vapor expansions during hypothetical core disruptive accidents in a fast test reactor are presented. Rigid cylinder-piston experiments performed at two scales (ratio 1:3) to determine a pressure–volume relationship as a function of source mass and expansion environment are described. Some of these measurements are compared with code calculations for the source. The results show: (1) that the pressure–volume relationship depends significantly on the presence of water in the cylinder and comparatively little on the timescale of the expansion, the presence of steel balls in the water, or a Mylar sheet on the water surface; and (2) the experiment's scale. A relationship between the measured work energy from the source and the charge mass is presented, and pressure–volume change measurements are compared with previous experimental measurements and with theoretical calculations for a 150 MWsec hypothetical core disruptive accident. The measurements and code calculations of the pressure–volume relationship for the source agree reasonably well. 7 references. (auth)

8713 REACTOR STRUCTURAL RESPONSE TO MOLTEN FUEL-COOLANT INTERACTIONS. Bratis, J. C.; Marciniak, T. J. (Argonne National Lab., IL). Nucl. Eng. Des.; 27: No. 1, 1-13(1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

In order to realistically determine the structural response of a liquid metal fast breeder reactor to a molten fuel–coolant interaction (MFCI), an MFCI region was incorporated into the two-dimensional, hydrodynamic containment code, REXCO-H. In this way, it is possible to account for the two-dimensional hydrodynamic response, as well as for the effect of vessels and plates, upon the expansion process in the MFCI region. The MFCI model has been extended in order to increase the usefulness of the code under a variety of conditions. The sodium equation of state has been improved using basic thermodynamic relations and recent data to incorporate temperature dependent properties. Heat transfer models available to describe the MFCI include not only a quasi-steady-state model, but also a parametric model, including the fuel heat of fusion. Nonhomogeneous MFCI regions can be treated by assigning different parameters to each zone within a region, including volume fractions of fuel, sodium, steel, and void, as well as initial fuel and coolant temperatures and fraction of molten fuel. Several cases have been studied in order to delineate the effect of various parameters on the peak pressures generated in the MFCI zones. These include effect of initial fuel and coolant temperatures, void fraction, amount of molten fuel and/or vessel wall compliance. The response of a typical reactor configuration is evaluated for a given set of initial conditions. 12 references. (auth)

8714 METHOD OF MEASURING THE TRITIUM CONCENTRATION IN A HIGH-TEMPERATURE ENVIRONMENT. Nelson, P. A.; Kumar, R. (to United States Atomic Energy Commission). US Patent 3,797,299. 19 Mar 1974. Filed date 23 Apr 1973. 12p.

The invention deals with a novel method for measuring the tritium concentration in a high-temperature environment such as liquid metal. An enclosed, thin-wall metal membrane is connected to a sweep gas source containing hydrogen in an inert carrier gas, the membrane being formed from a metal substantially inert to the high-temperature environment and through which elemental hydrogen and tritium will diffuse. The outer surface of the metal membrane is then contacted with the high-temperature environment, and the interior surface of the membrane is contacted and swept by the sweep gas, whereby tritium atoms diffusing through the walls of the membrane react with the hydrogen in the sweep gas at the interior surface of the membrane to form gaseous hydrogen tritium molecules which are immediately swept away from the membrane's interior surface. The sweep gas containing the gaseous hydrogen-tritium molecules is continuously removed from the enclosed membrane and measured for tritium radioactivity, the radioactivity measurement being indicative of the tritium concentration in the high-temperature environment. (Official Gazette)

8715 EXPERIMENTAL INVESTIGATION OF SIMULATED TEMPERATURE CONDITIONS IN FUEL ELEMENTS OF REACTOR BOR-60. Subbotin, V. I.; Zhukov, A. V.; Pasek, M.; Sviridenko, E. Ya.; Ushakov, P. A.; Sulc, V. (State Committee for Atomic Energy, Obninsk, USSR). pp 238-249 of Simulation Techniques in the Investigation of Thermokinetic Effects in the Core of Fast Reactors. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Babylon, Czechoslovakia (23 Feb 1970).

The results are discussed of temperature field studies conducted on the models of BOR-60 reactor fuel elements. The computational formulas and graphical relationships are given used in evaluating temperature irregularities in the lateral, corner, and central elements of the fuel element assembly and in determining the heat transfer coefficients in an "infinite" grid over a wide range of Re numbers (turbulent, laminar, and transient flow of coolant). The effect of cylindrical spacers and of wire coiling is discussed in detail on the temperature fields of the elements. Data are analyzed relating to the stabilization of temperature fluctuations of the central and peripheral elements, the changes in the liquid temperature along the diameter of the fuel assembly, and the effect of convection on the temperature field of the fuel element. The experimental data are recalculated for the reactor operating conditions of the fuel element. (Nucl. Sci. Abstr. Czech.)

8716 START-UP OF THE BN-350 REACTOR. Jad. Energ.; 20: No. 2, 61-66(1974). (In Czech).

The preparation of the coolant for the primary and secondary circuits of the BN-350 reactor is described. The preliminary studies made on the primary, secondary, and tertiary circuits of the reactor are discussed. The results of the experimental study of the dynamic characteristics and parameters and of the physical characteristics of the reactor are reported. 16 references. (JSR)

Research, Test, and Experimental Reactors

Refer also to abstracts 8655, 8694, 8699, and 8700.

8717 (BARC/I-206) APSARA CORE FUELING WITH PLUTONIUM ELEMENTS. Nath, M.; Gaur, S. P. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 15p. INIS.

The various aspects of the partial replacement of spent uranium fuel elements in Apsara reactor core with the fresh plutonium fuel elements for increasing the burnup level of the uranium fuel elements are studied. The heat transfer characteristics and reactor physics parameters of the plutonium fuel elements must be similar to those of the uranium fuel elements. A comparative study of the various reactivity coefficients such as moderator temperature, fuel burnup and void of these fuel elements reveals that they match well in the operating range of temperatures and small burnup levels. Introduction of the plutonium fuel elements in a partially spent uranium core changes the core characteristics such as core excess reactivity, distribution of radial power and radial flux, xenon poisoning, core kinetics, hydraulic and heat transfer characteristics. Corresponding changes which have to be made in the existing reactor safety system such as shim limit, trip settings, shim rods, withdrawal rate, shim rods shutting-down capacity, worth of fine regulating plate and reactivity burnup rate are discussed in detail. Finally, for fuel management, the rate of requirement of fresh plutonium fuel elements per year is calculated. (INIS)

8718 (BARC/I-207) APSARA CORELIFE WITH SECOND FUEL CHARGE. Nath, M.; Gaur, S. P. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 17p. INIS.

The corelife of APSARA reactor has been estimated in view of reactivity burnup for the full charge of 80% enriched uranium fuel. To start with, the reactor is assumed to be fully loaded with fuel and reflector elements such that the resulted core configuration exhibited the maximum core excess reactivity with due regards to certain constraints in reactor loading. In order to obtain a reasonable estimate of corelife, three different methods have been considered for core burnup calculations. In the first method, the core excess reactivity is worked out as a function of uniform core burnup. In the second method, the core excess reactivity is simulated by the concentration control of a uniformly distributed poison in the core in order to keep the reactor critical during fuel burnup, that is, from first start-up to final shutdown. The third method is based upon a practical approach to obtain the maximum global fuel burnup. In this last method, the core is burned non-uniformly and then the fuel elements are shuffled within the core in such a way that a maximum value of core excess reactivity is achieved and hence further core burnup yields the longer corelife. A uniform core burnup of about 22% can be achieved for full fuel charge. The optimum method (third approach) hardly increases average fuel burnup by 0.4% of the initial charge as compared to other uniform core burnup methods. (auth)

8719 (BARC/I-208) REACTIVITY-DOUBLING TIME RELATION FOR COMPOSITE CORES OF APSARA REACTOR. Nath, M.; Gaur, S. P. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 13p. INIS.

The core kinetics of a composite core containing more than one type of fissile nuclides have been studied. In particular, the reactivity-doubling time relation has been modified for composite cores of Apsara reactor consisting of uranium and plutonium fuel elements. The modification includes the relative increased importance of delayed neutrons over prompt neutrons because of their different non-leakage probabilities from the core and the correction due to different neutron generation rates of different fissile species in different neutron concentration zones in the composite core. In order to utilize this relation in practice, a computer program HEMA has been written to calculate the tables of reactivity as a function of reactor doubling time. From the study, three important conclusions have been drawn: the reactivity-doubling time relation remains practically unaffected due to non-uniformity in fuel concentration or flux distribution so long as single type of fissile nuclides is present in the core; a change in core buckling (or core size) has a little effect on reactivity-doubling time relation; and the presence of plutonium fuel elements in a uranium core strongly affects the reactivity-doubling time relation. (auth)

8720 (FRNC-TH-458) EXPERIMENTAL STUDY OF THE k(inf) = 1 METHOD FOR MEASURING THE NEUTRON BALANCE OF FAST NEUTRON MULTIPLYING MEDIA. Application to Boron Poisoned Metallic Uranium and Plutonium Lattices in the Coupled Thermal Fast Neutron Ermine Assembly. Marimbeau, P. (Paris-11 Univ., 91-Orsay (France)). 1973. 183p. (In French). Dep. NTIS (US Sales Only) $12.25.

Thesis.

The $k_\infty = 1$ method was developed to measure the neutron balance in leakproof media. Measurements were made in the coupled thermal-fast neutron Ermine experiment. In order to make the multiplicity coefficient equal to 1, a high capture cross section substance (boron) was used to poison the lattice. In one case the lattice fuel was 30% ^{235}U enriched uranium (KU2) and in two other cases was the MASURCA U-Pu-Fe alloy (KP1 and KP2); comparisons made of the results obtained enabled the MASURCA metallic fuels to be compared. The size of the test zone (50 litres) is sufficiently large to permit the equilibrium spectrum to be obtained at the center over a sufficiently large volume. The radial matching does not present any special difficulties even though the zone from which the feeding takes place is completely radial. A correctly matched radial lid serving as a reflector) leads to large extrapolated values (one meter) and thus to practically flat fluxes over a sufficient measurement height. Measurements made of the degree of vacuum in the cell are interpreted in such a way as to give a correct formula with a directly calculable coefficient which leads to the k^+ parameter. The three dominant causes of uncertainty in determining the void effect of the cell are presented: spacing effects; cavity size effects (gradients) which can be limited with a moderator diluent; composition corrections. A normalization effect (^{235}U and ^{239}Pu) and two calculated coefficients (m and epsilon) were used to interpret k^+. The matching epsilon correction is the most difficult to suppress. In the case of the balance interpretation, the causes of the uncertainty depend on the final term to be extracted. The principal correction applied in determining α_5, α_9 or even an average eta value for the fuel is that due to boron capture. The utilization of this method enabled an accuracy of 400 pcm to be obtained for k^+. The results obtained are in good agreement with the corresponding English and German experiments. (FR)

8721 (HEDL-SA-684) FTR SODIUM COOLANT ACTIVITY. Kidman, R. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-2170. 4p. (CONF-740608-8). Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

An estimate of the overall activity in the sodium coolant of the FFTF Reactor is presented. (JWR)

8722 (HEDL-TME-74-7) FAST TEST REACTOR SODIUM ACTIVITY. Kidman, R. B.; Marr, D. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-2170. 24p. AT.

Experiment-theory comparisons performed on a detailed engineering mock-up of the Fast Test Reactor (FTR) are used to obtain an experimentally correlated value for the FTR sodium-coolant activity. The resulting FTR sodium gamma activity is 4.87 megacuries ±5.4% (or 9.68 millicuries per cubic centimeter ±5.4%, assuming 17,760 cubic feet of sodium coolant). (auth)

8723 (IAEA-R-1027-F) DETERMINATION OF NEGATIVE REACTIVITIES IN A SUBCRITICAL ASSEMBLY BY MEANS OF NEUTRON STATISTICAL FLUCTUATION. Final Report, July 1 1971–June 30, 1972. Montes, J. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. 24p. INIS.

The application of Feynman's method of neutron statistical fluctuations to the determination of negative reactivities and some other parameters of the subcritical assembly JEN-2 were studied. The main experimental method was based on Feynman's formula describing the variance to mean ratio of the number of counts collected by a neutron detector. The statistical analysis was carried out to determine the best procedure for sampling and the criteria for selecting the reliable samples. Two types of experiments were conducted. In the first one the level of subcriticality was varied by inserting one of the control plates into different positions. For the second experiment four fuel plates were added. The experiment consisted of withdrawing these plates successively and making measurements at each stage. Negative reactivities at different subcritical levels, from 0 to −0.7 $ were measured. Effective delayed neutron fraction, β, and effective lifetime of neutrons, l, were determined. Control element calibration and fuel importance function measurements were carried out. Various approaches of the treatment of the experimental data obtained were analyzed. The determinations of the parameter β/l from both experiments are in good agreement. (INIS)

8724 (IRS-R-3) IN-SERVICE INSPECTIONS IN RESEARCH REACTORS. Recommendations for Routine Recurring Tests of the Safety of Research Reactors. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Oct 1973. 12p. (In German). INIS.

A recommended version of the guidelines to be consulted for licensing and supervisory purposes is presented. This version was discussed by the subcommittee on nuclear plants of the Committee of the Laender on nuclear energy on Sept. 23, 1973 and was worked out originally on behalf of the Federal Ministry for Education and Science by the task group for operational and safety problems of research reactors, the Technical Surveillance Associations and the Institute for Reactor Safety, Cologne. (GE)

8725 (JINR-P3-7729) POSSIBLE METHOD FOR EXTRACTION OF ULTRA-COLD NEUTRONS FROM THE REACTOR AND THEIR STORAGE. Golikov, V. V.; Taran, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

A method is suggested for the extraction of ultracold neutrons from a reactor moderator with a cutoff velocity comparable to or greater than that for the transporting neutron guide tube. The neutrons are extracted by means of a magnetic field of requisite intensity superimposed on the moderator. The method consists in delaying the neutrons (with antiparallel spin projection with respect to magnetic field direction) in a decreasing, out-of-the-moderator magnetic field and in their further transporting by conventional neutron guide tube. On the basis of this method there is suggested a principal construction of a lock for the ultracold neutron storage device used with pulsed and steady-state reactors. (3 figures) (auth)

8726 DELAYS AND COST INCREASES FOR THE FFTF. Com. Naz. Energ. Nucl., Notiz.; 20: No. 3, 39-42(Mar 1974). (In Italian).

8727 ENVIRONMENTAL RADIATION AT THE EBR-II SITE. Gold, R. (Joint Center for Graduate Study, Richland, WA); Oltman, B. G.; Eckerman, K. F.; Strash, A. M. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 596-601(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The present environmental radiation state of the EBR-II site has been explored through application of new and highly sensitive methods which have resolved the environmental gamma and meson components at this highly relevant LMFBR site. The external gamma-ray radiation dose rate in the immediate vicinity of EBR-II (for gamma rays of energy in excess of 220 keV) was observed to be about 6 μrad/hr. The cosmic-ray meson component contributes an additional dose rate of about 4.5 μrad/hr. These two components result in an annual external dose to man of approximately 92 mrads. Although analysis of the gamma-ray spectra and soil samples reveals that the gamma-ray component is overwhelmingly derived from naturally occurring isotopes, statistically significant amounts of ^{137}Cs and ^{125}Sb (fission products) were observed in soil samples collected during this site survey. In addition, sizeable variations in the observed concentrations of ^{125}Sb, ^{137}Cs, ^{238}Pu, and ^{239}Pu of these EBR-II soil samples would appear to imply a non-uniform deposition pattern. However, the observed non-uniformity could be due to either local releases of fission products or drifting of surface soil containing fallout products. While fallout is certainly a significant contribution to the measured deposition, observed patterns and correlations qualitatively suggest that very low level releases could possibly have occurred at the EBR-II site some time in the past. Quantitative conclusions cannot possibly be based upon the very limited data available from the present site survey. In any event, dose rate observations obtained in this survey prove that whether or not such releases have occurred, they can only represent but a small perturbation in the natural radiation environment indigenous to the EBR-II site. (auth)

8728 ONLINE MONITORING OF SPECIFIC RADIONUCLIDES IN GASEOUS EFFLUENTS. Walker, D. M.; McLain, M. E. Jr.; Hearn, R. A. Jr. (Georgia Inst. of Tech., Atlanta). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 484-490 (Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A feasibility study of automatic online monitoring of specific radionuclides in nuclear plant gaseous effluents is being conducted at the Georgia Tech Research Reactor (GTRR). An inpile loop experiment has been designed, built, and operated in the GTRR to simulate gaseous effluent mixtures anticipated for a variety of reactor situations. The gaseous fission product mixture may be altered by varying the flow rate of the helium sweep gas over the uranium-235 loaded microporous target, the neutron flux and temperature at the target, and the configuration of the cryogenic trapping system external to the reactor. The loop is used for experiments in remote monitoring of specific radionuclides to be experienced for normal, minor malfunction, and accident conditions at a nuclear plant. As a means of evaluating the practical aspects of automatic online monitoring, a remote monitoring system has been designed and built to measure nuclear and meteorological data at the GTRR, and to transmit the data to a central computer on either a routine "record keeping" or on an emergency-interrupt basis. The measurement system can be adjusted from the remote location to allow live time probing of conditions at the monitored location. (auth)

8729 APPLICATION OF AN ON-LINE DIGITAL COMPUTER AT EBR-II. Hyndman, R. W.; Tuck, M. R.; Tucker, K. D. (Argonne National Lab., IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 776-783(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A brief description of the EBR-II reactor and its supporting digital computer (which was designed to be transparent to the operator or experimenter) are discussed. Details of the system hardware and software are noted which allow the system to function as an operational and experimental support tool. Two types of experiments are discussed which demonstrate use of operational data for experimental support and the use of the computer in a dedicated experiment. (auth)

8730 EXPERIENCE WITH A DIGITAL NOISE ANALYSIS SYSTEM IN SUBCRITICALITY MEASUREMENTS ON A MOCKUP OF THE FFTF. Pare, V. K.; Kryter, R. C.; Mihalczo, J. T. (Oak Ridge National Lab., TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 767-770(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A digital Fourier analyzer was programmed to perform reactor neutron noise analysis measurements and on-line processing of the data to obtain the steady-state reactivity. The system is suitable for recovering cross spectral density with low correlated-signal component and for repetitive measurements with efficient use of reactor time. (auth)

8731 REAL TIME ANALYZER FOR INVERSE KINETICS ROD DROP EXPERIMENTS. Churchich, M. K. (Oak Ridge National Lab., TN); Mott, J. E.; Robinson, J. C.; Piety, K. R. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 771-775(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

A system is described that measures subcritical reactivity in nuclear reactors by the Inverse Kinetics Rod Drop (IKRD) technique. The analyzer was used in a large scale reactivity experiment performed in the Fast Flux Test Facility (FFTF) engineering mock-up core loaded in the ZPR-9 at Argonne National Laboratory. The hardware used in the system included a computer operating in a real time environment, an interface to condition the signals from seven neutron sensors located in the reactor

core and to transfer them into the computer at fixed time intervals (provisions were made to interface signals from individual neutron detectors operating in either the current or the pulse mode of operation), and a cassette tape recorder for permanent storage of the raw data. This system performs the following functions: (1) Examination of data from a preselected neutron sensor during the steady state operation to determine when the transient (rod drop) begins; (2) Simultaneous acquisition and storage of data from all sensors once the test is in progress; (3) Solution of the inverse kinetics equation for each of the seven sensors in real time by the three point method; and (4) Display of significant results immediately after the conclusion of the test. The system allows the operator to determine the reactivity condition of the reactor immediately. (auth)

8732 RESULTS IN THE APPLICATION OF PATTERN RECOGNITION METHODS TO NUCLEAR REACTOR CORE COMPONENT SURVEILLANCE. Gonzalez, R. C.; Fry, D. N.; Kryter, R. C. (Oak Ridge National Lab., TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 750-756(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Pattern recognition methods were applied to analyze and interpret neutron noise data from the High Flux Isotope Reactor (HFIR) at ORNL. The results show that it is feasible to detect some core component failures by means of machine-discernible differences in the time-dependent noise power spectra. These neutron spectra (signatures) were analyzed by using a cluster-seeking algorithm to derive a set of templates for automatic computer evaluation of the reactor's mechanical integrity and soundness. (auth)

8733 FAST NEUTRON HODOSCOPE AT TREAT: OPERATIONAL EXPERIENCE AND IMPROVEMENTS. De Volpi, A. (Argonne National Lab., IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 784-787(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The multichannel hodoscope at TREAT is capable of detecting motion of fuel resulting from intentional meltdown of fuel pins contained within a test capsule. The system has been in operation in its present form since 1969, having participated in over 50 transients. Operational experience and evolutionary improvements are the subject matter of this report. The rather complex hodoscope system, which is supported by an involved series of steps before results can be achieved, has worked well within design prediction. Computer-aided reconstruction of the data has been provided to obtain displays, plots, and movies of fuel motion events. (auth)

8734 OPTIMIZATION OF THE CLIPPING TIME CONSTANT FOR BF_3 NEUTRON DETECTORS OPERATED IN A HIGH LEVEL GAMMA ENVIRONMENT. Brown, D. P. (Westinghouse Hanford Co., Richland, WA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 763-766(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Radiation-hardened BF_3 neutron detectors (proportional counters) have been selected for use as delayed neutron detectors in the failed fuel monitoring system of the Fast Flux Test Facility (FFTF) being constructed by the Westinghouse Hanford Company at Richland, Washington. These detectors must exhibit approximately 6 to 7 counts/sec (cps) per neutron/cm^2-sec (nv) for neutrons while operating in a gamma environment of about 1000 R/hr; thus, electronic counting systems capable of providing the best possible sensitivity must be used. In addition to exhibiting appropriate charge gain and sufficiently low noise, the preamplifier (or amplifier) must include at least one stage of differentiation to reduce gamma interference (pulse pileup) effects. The selection of the time constant depends on the rise time of the neutron-caused pulse from the BF_3 tube and on the maximum gamma level in which the tube must operate. The conflicting requirements of large time constant to maintain pulse amplitude and small time constant to reduce gamma effects lead to an optimum value to achieve the best possible neutron detection sensitivity. (auth)

8735 DYNAMIC MODEL OF THE ROSSENDORF RESEARCH REACTOR VVR-SM. Fuge, R.; Grundmann, U.; Otto, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 17: No. 2, 47-53(Feb 1974). (In German).

A simple equation for feedback reactivity may be derived for the reactor transients. The frequency response in the range of 10^{-3} up to 1 cps has been measured for various power levels using the binary pseudo-random reactivity perturbation method. The model parameters have been fitted to the measuring values by nonlinear optimization. Theory and experiment point out that for frequencies above 10^{-2} cps the reactor practically shows zero-power behavior. (auth)

8736 MEASUREMENT OF β_{eff} FOR THE RESEARCH REACTOR FRG USING THE SUBSTITUTION METHOD. Krull, W. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht-Tesperhude, Ger.). Atomkernenergie; 22: No. 4, 290(1974). (In German).

For the core 14a of the FRG reactor, the effective delayed neutron fraction $\beta_{eff} = 0.0084$ was measured with the help of pile replacement techniques. (GE)

8737 DETERMINATION OF EXCESS REACTIVITY BY MEASUREMENT OF THE DECAY CONSTANTS OF PROMPT NEUTRONS IN DELAYED CRITICAL AND SUBCRITICAL STATES. Robinson, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomkernenergie; 21: No. 1, 71(1971). (In German). (GKSS-73/E/26).

An experiment is described for determining excess reactivity from subcritical reactivity values, provided that either the generation time or the lifetime of prompt neutrons remains constant in the transition from delayed critical to prompt critical state. Subcritical reactivities and effective delayed neutron fractions are determined by measuring the prompt neutron decay with pulsed neutron techniques. (GE)

Production and Materials Testing and Processing Reactors

Refer also to abstract 6085.

8738 (DUN-7308-F) PT-N-241, N REACTOR RUPTURE MONITOR FLOW DETERMINATION. Final Report. Newell, L. J. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 6 Dec 1973. Contract AT(45-1)-1857. 5p. Dep. NTIS $4.00.

In performing primary loop leak analysis, it is necessary to find the difference between injection flow and sum of several bleed flows. One of the bleed flows that is used is the flow through the rupture monitor system. There is no installed instrumentation for monitoring this system flow. Consequently, PT-N-241, "N Reactor Rupture Monitor Flow Determination," was designed to permit periodic determination of the amount of primary coolant flow passing through the rupture monitor system during reactor operation. Initial performance of PT-N-241 took place on October 8, 1971. The results obtained from PT-N-241 testing are presented. (auth)

8739 (DUN-7983(Rev.1)) PROCESS APPLICATION COMPUTER PROGRAMS. Bartlett, R. J. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 18 Apr 1973. Contract AT(45-1)-1857. 20p. Dep. NTIS $4.00.

Programs and techniques used in the computer process support system at the N Reactor are described. (JWR)

8740 (DUN-8005-C) RERUN OF PT-N-315, SET POSITION LIMITS ON N REACTOR WATER INJECTION IWV-253 VALVES. Final Report. Wellner, T. A. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 30 Aug 1973. Contract AT(45-1)-1857. 10p. Dep. NTIS $4.00.

The setting of the IWV-253 valves is critical since they limit the flow through the high pressure injection water pumps. During a reactor scram, these valves open to a pre-set position so that the maximum desired flow for the number of pumps running is not exceeded. If the flow on any pump exceeds a certain limit, the pump could go into cavitation resulting in loss of makeup water to the primary loop. The maximum safe limit now being applied has been established at 1700 gpm per pump at a minimum demineralized water tank level of $^1/_4$ full, or about 8 feet. This test was initiated to resolve uncertainties in the IWV-253 valve opening limits for the case of one, two, three, and four pumps in operation. A dynamic test was necessary to compensate for varying system parameters. All high pressure injection pumps flow into a common header. The tests for three and four pumps in operation were not performed since it was felt that the back pressure in the header would be sufficient to limit the HPIP flows. The test on one pump in operation was not performed since the chances of a simultaneous scram, electrical bus failure, and the remaining HPIP not starting are low. The case of greatest concern is an electrical bus failure and a scram, which would leave two HPIPs in operation. The IWV-253 valve limits were set for this case. (auth)

8741 (GEX-R-152) REACTIVITY EFFECTS MEASUREMENTS IN BR2 DURING 1972. Beeckmans de West-Meerbeeck, A.; Lenders, H.; Leonard, F. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 10 Oct 1973. vp. (In French). INIS.

Propulsion and Package Reactors

Refer also to abstracts 8901 and 8914.

8742 (CNLM-5325(Vol.2)) PROPOSAL SECOND GENERATION PORTABLE NUCLEAR POWERPLANT. Volume II. Field Powerplant. (Pratt and Whitney Aircraft, Middletown, Conn. (USA); Stone and Webster Engineering Corp., Boston, Mass. (USA)). 1963. 117p. Dep. NTIS $9.00.

Declassified 18 Sep 1973.

A portable nuclear powerplant employing a liquid metal cooled reactor as a heat source and an open cycle gas turbine as a power converter is described. The reactor is cooled by liquid potassium and has an intermediate heat exchanger and a sodium–potassium secondary coolant circuit. Aspects discussed include plant design, assembly and operation, safety, powerplant economics, and future improvements. (JWR)

8743 USES OF NUCLEAR ENERGY IN SPACE FLIGHT. II. Hollax, E. (Astronautische Gesellschaft, Dresden). Kernenergie; 17: No. 2, 34-41(Feb 1974). (In German).

Problems and possibilities of using nuclear energy in space flight for production of transport energy, heat energy, and chemical energy as well as for analytical purposes are described. Some examples of past or future applications are explained. (auth)

8744 2ND SYMPOSIUM ON URANIUM PLASMAS: RESEARCH AND APPLICATIONS. Conference held at Atlanta, Georgia, November 15–17, 1971. New York; American Institute of Aeronautics and Astronautics (1971). 296p. (CONF-711124-). $40.00

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971).

Information on the application of uranium plasmas is presented concerning nuclear power and lasers, nuclear plasma physics, radiant heat transfer, open-cycle gas-core rocket engines, and nuclear light bulb rocket engines. Separate abstracts are included for each of the 41 papers presented. (DCC)

For abstracts of individual papers see: 6223, 6247, 6277, 6380, 6430–6432, 8684–8691, 8709, and 8745–8769.

8745 FISSION ENGINE CONCEPTS. Thom, K. (Space Nuclear Systems Office, Washington, DC). pp 3-17 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Information on fission engine concepts is presented concerning plasma-core nuclear rocket concepts, fissioning plasmas, colloid core nuclear rocket concepts, and the nuclear piston engine. 29 references. (DCC)

8746 PERFORMANCE POTENTIAL OF GAS-CORE AND FUSION ROCKETS: A MISSION APPLICATIONS SURVEY. Fishbach, L. H.; Willis, E. A. Jr. (Lewis Research Center, Cleveland). pp 18-27 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

An evaluation is presented of the performance potential of five nuclear rocket engines for four mission classes. These engines are: the regeneratively cooled gas-core nuclear rocket; the light bulb gas-core nuclear rocket; the space-radiator cooled gas-core nuclear rocket; the fusion rocket; and an advanced solid-core nuclear rocket which is included for comparison. The missions considered are: Earth-to-orbit launch; near-Earth space missions; close interplanetary missions; and distant interplanetary missions. For each of these missions, the capabilities of each rocket engine type are compared in terms of payload ratio for the Earth launch mission or by the initial vehicle mass in Earth orbit for space missions (a measure of initial cost). Other factors which might determine the engine choice are discussed. It is shown that a 60 day manned round trip to Mars is conceivable. 13 references. (auth)

8747 INSTABILITIES IN URANIUM PLASMA. Tidman, D. A. (Versar Inc., Springfield, VA). pp 99-104 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The nonlinear evolution of unstable sound waves in a uranium plasma has been calculated using a multiple time-scale asymptotic expansion scheme. The fluid equations used include the fission power density, radiation diffusion, and the effects of the changing degree of ionization of the uranium atoms. The nonlinear growth of unstable waves is shown to be limited by mode coupling to shorter wavelength waves which are damped by radiation diffusion. This mechanism limits the wave pressure fluctuations to values of order $\delta P/P \sim 10^{-4}$ in the plasma of a typical gas-core nuclear rocket engine. The instability is thus not expected to present a control problem for this engine. 4 references. (auth)

8748 MEASURED EMISSIVITIES OF URANIUM AND TUNGSTEN PLASMAS. Miller, M. H. (Univ. of Maryland, College Park). pp 117-122 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Uranium and tungsten absorption coefficients between 2,500–8500 Å were measured as functions of thermodynamic variables. A gas-driven shock tube was used to obtain plasma temperatures, heavy metal partial pressures and total pressures in the ranges 7,000–12,000°K, 0.02–1.0 ATM and 3.0–48. ATM, respectively. Emission and absorption data were recorded both photographically and photoelectrically. The spectral distributions, thermal dependence and line-to-continuum ratios of the uranium and tungsten radiation differ distinctly. The uranium data are compared with theoretical predictions and with results from other experiments. 16 references. (auth)

8749 OPACITY OF TUNGSTEN-SEEDED HYDROGEN TO 2500°K AND 115 ATMOSPHERES. Williams, J. R.; Partain, W. L.; Clement, J. P. (Georgia Inst. of Tech., Atlanta). pp 123-136 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Aerosols of submicron-sized refractory particles are currently being considered as propellants for gas core rockets and for thermal radiation shielding in nuclear rocket nozzles. In order to be useful for these applications, the particles should be strongly absorbing in the ultraviolet, visible, and near infrared regions of the spectrum and should withstand high temperatures at high pressures without reacting or vaporizing. Submicronsized particles of refractory metals generally satisfy both of these requirements. Measurements of the extinction parameter of tungsten-hydrogen aerosols were made as a function of wavelength from 2500 Å to 5800 Å at pressures from 1 to 115 atmospheres and temperatures from 300°K to 2500°K. 27 references. (auth)

8750 MEASUREMENT OF THERMAL RADIATION SCATTERING CHARACTERISTICS OF SUBMICRON REFRACTORY PARTICLES. Jacobs, W. R.; Williams, J. R. (Georgia Inst. of Tech., Atlanta). pp 137-143 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The differential scattering parameter has been measured for 0.04 micron tungsten particles in hydrogen and nitrogen at temperatures to 1088°K. The differential scattering parameter has also been measured for 0.1 micron tungsten, three types of carbon particles, and fly ash in nitrogen at temperatures to 1000°K. By integrating the differential scattering parameter over 4π steradians, the total scattering parameter may be evaluated. 19 references. (auth)

8751 SHOCK TUBE TECHNIQUE FOR MEASURING OPACITIES AT HIGH PRESSURES FOR GASEOUS-CORE NUCLEAR ROCKETS. Patch, R. W. (Lewis Research Center, Cleveland). pp 144-149 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

A nonexplosive shock tube which should have higher performance than previous nonexplosive shock tubes is described. This shock tube should produce essentially homogeneous, isothermal gases or aerosols at conditions occurring in the propellant region in a gaseous-core nuclear rocket. The shock tube is currently under construction. A unique method of measuring the Planck and Rosseland mean opacities of shock tube gases without using high spectral resolution is derived. The selection of seed materials to be added to the gases to make them semi-opaque is discussed. 23 references. (auth)

8752 MEASUREMENTS OF SPEEDED ARGON-HYDROGEN PLASMA PROPERTIES. Benns, R. A.; Thompson, S. D.; Williams, J. R.; Clement, J. D. (Georgia Inst. of Tech., Atlanta). pp 150-155 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Seeded argon-hydrogen plasmas have been produced at Georgia Tech in order to experimentally measure composition, temperature, radiant heat output and opacity. The plasma, seeded with submicron tungsten particles, simulates the propellant of a gaseous core nuclear rocket. These measurements are needed to predict the dynamic behavior of the operating gas core reactor. The temperature range in which the seed has vaporized but the hydrogen itself has not yet become opaque is known as the seed-hydrogen opacity window. Preliminary opacity data in this temperature range will be presented. 19 references. (auth)

8753 EXPERIMENTAL INVESTIGATION TO SIMULATE PROPELLANT HEATING IN THE NUCLEAR LIGHT BULB ENGINE. Klein, J. F. (United Aircraft Research Labs., East Hartford, CT). pp 156-162 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Experiments to heat a simulated propellant to high bulk temperatures by the absorption of thermal radiation are discussed. Argon seeded with micronsized carbon particles was used as the simulated propellant; a 500 kw d-c arc was used as the radiant energy source. Bulk temperatures up to 3860°K were obtained with greater than 95 percent of the incident radiation absorbed. The arc radiation source, seed dispersal equipment, techniques used to prevent transparent wall coating by the seeds, and calorimetric measurement of bulk temperature are also discussed. 6 references. (auth)

8754 RADIATION HEAT TRANSFER CALCULATIONS FOR THE URANIUM FUEL-CONTAINMENT REGION OF THE NUCLEAR LIGHT BULB ENGINE. Rodgers, R. J.; Latham, T. S.; Krascella, N. L. (United Aircraft Research Labs., East Hartford, CT). pp 163-169 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The nuclear light bulb engine concept is based on the transfer of energy by thermal radiation from gaseous uranium fuel in a neon vortex, through an internally cooled transparent wall, to seeded hydrogen propellant. Spectral distributions of radiant energy emitted from the nuclear fuel region and incident on the transparent wall structure were calculated using a neutron transport theory code. The spectral heat fluxes and corresponding radial temperature distributions were used to calculate the heat loads in the buffer gas and transparent walls due to absorption of radiant energy. 5 references. (auth)

8755 NOZZLE AND CAVITY WALL COOLING LIMITATIONS ON SPECIFIC IMPULSE OF A GAS-CORE NUCLEAR ROCKET. Kascak, A. F. (Lewis Research Center, Cleveland). pp 173-178 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The uranium plasma nuclear rocket is a proposed device which features a high specific impulse. The objective of this study was to find the upper limit of the ability of the seeded hydrogen propellant to intercept the thermal radiation from the high temperature fuel and thus protect the reactor cavity wall from excessive heat flux. This limit fixes the maximum reactor power that can be used for a fixed propellant flow rate; and determines the maximum achievable cavity specific impulse. This maximum cavity propellant temperature can then be used to find the amount of nozzle wall seeded transpiration flow that is necessary. This required nozzle coolant flow reduces the maximum cavity specific impulse to some lower value that is the maximum specific impulse such as an engine system can provide. 8 references. (auth)

8756 OPEN-CYCLE GAS-CORE NUCLEAR ROCKET ENGINE: SOME ENGINEERING CONSIDERATIONS. Taylor, M. F.; Whitmarsh, C. L. Jr.; Sirocky, P. J. Jr.; Iwanczyk, L. C. (Lewis Research Center, Cleveland). pp 179-188 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

A preliminary design study of a conceptual 6000-MW open-cycle gas-core nuclear rocket engine system was made. The engine has a thrust of 44,220 lb and a specific impulse of 4400 sec. The nuclear fuel is uranium-235 and the propellant is hydrogen. Critical fuel mass was calculated for several reactor configurations. Major components of the reactor (reflector, pressure vessel) and the waste heat rejection system were considered conceptually and were sized. 15 references. (auth)

8757 EFFECT OF BUOYANCY ON FUEL CONTAINMENT IN AN OPEN-CYCLE GAS-CORE NUCLEAR ROCKET ENGINE. Putre, H. A. (Lewis Research Center, Cleveland). pp 189-196 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

In the latest open-cycle gas-core concept, the large fuel-to-propellant density ratio of 10 or more, coupled with a vehicle acceleration of approximately 0.02 "g" would cause a buoyancy force which would tend to reduce the amount of fuel contained in the cavity. This effect of buoyancy on fuel containment would depend on various engine flow parameters. Scaling laws are determined for the buoyancy effect so that experimental conditions can be related to the engine conditions. The fuel volume fraction (proportional to the contained fuel mass) in a short coaxial flow cavity is calculated with a programmed numerical solution of the steady Navier-Stokes equations for isothermal, variable density fluid mixing. The solution includes buoyancy, pressure gradient, and viscous shear terms, as well as the effects of side and end walls. Solutions are obtained at a propellant-to-fuel flow ratio of 50 and a Reynolds number of 1000, for fuel-to-propellant density ratios ranging from 1.0 to 10, and for various vehicle accelerations. The main limitation of the analysis is that the numerical solution fails to converge for Reynolds numbers above about 1000. 6 references. (auth)

8758 FLOW AND CRITICALITY IN THE OPEN CYCLE GAS CORE. Kunze, J. F.; Lofthouse, J. H. (Aerojet Nuclear Corp., Idaho Falls, ID). pp 197-203 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

A series of flowing gas experiments using air, argon, and freon has been conducted in Idaho. The purpose is to study methods of obtaining flow patterns which would create maximum possible system reactivity consistent with an acceptably low uranium to coolant-gas loss ratio. These have been conducted on both "two-dimensional" and truly three-dimensional spherical configurations of diameters 18 to 42 inches. The larger diameter is that proposed for a minimum cost flowing gas critical experiment, and the size extremes make extrapolations to the large 6 and 8 foot diameter configurations more reliable. Results show that large enough inner gas (fuel) volume fractions can be achieved to attain criticality. 8 references. (auth)

8759 EXPERIMENTAL STUDY OF THE EFFECTS OF INJECTION CONDITIONS ON THE FLOW IN CYLINDRICAL AND SPHERICAL CHAMBERS. Johnson, B. V.; Bennett, J. C. Jr. (United Aircraft Research Labs., East Hartford, CT). pp 204-213 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Fluid mechanics experiments were performed in cylindrical and spherical chambers to evaluate the simulated-fuel containment resulting from various injection geometry and inlet flow conditions for application to the open-cycle GNR. A preliminary study in the cylindrical chamber was directed toward developing inlet flow conditions which minimize mixing between the simulated fuel and propellant. Gas concentration measurements were obtained at several outer-stream to inner-stream weight flow and density ratios for the best inlet configuration tested in the preliminary study. The spherical cavity flow study was conducted to evaluate techniques for injecting simulated-fuel and propellant into a cavity. 10 references. (auth)

8760 ANALYSIS OF THE FIELD NEAR THE FUEL INJECTION LOCATION IN A GAS CORE REACTOR. Weinstein, H.; Murty, B. G. K.; Porter, R. W. (Illinois Inst. of Tech., Chicago). pp 214-220 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

An analytical study is presented which shows the effects of large energy release and the concurrent high acceleration of inner stream fluid on the coaxial flow field in a gas core reactor. The governing equations include the assumptions of only radial radiative transport of energy represented as an energy diffusion term in the Euler equations. The method of integral relations is used to obtain the numerical solution. Results show that the rapidly accelerating, heat generating inner stream actually shrinks in radius as it expands axially. 10 references. (auth)

8761 DYNAMIC ANALYSIS OF THE COAXIAL FLOW GASEOUS CORE NUCLEAR REACTOR. Turner, J. H. Jr.; Clement, J. D. (Georgia Inst. of Tech., Atlanta). pp 221-224 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

A mathematical model of the coaxial flow gaseous core nuclear reactor system has been derived and a computer program written to solve the resulting equations. The equations were derived from elementary neutron, heat, and mass balances on the components of the system and from previously derived correlations. Propellant flow out of the cavity was assumed to be governed by the choked-flow equation; no spatial variations were taken into account. The system response to several types of perturbations, the model's sensitivity to variations in reactivity coefficients and the suitability of several types of control systems were evaluated. 9 references. (auth)

8762 CREW RADIATION DOSE FROM THE PLUME OF A HIGH IMPULSE GAS-CORE NUCLEAR ROCKET DURING A MARS MISSION. Masser, C. C. (Lewis Research Center, Cleveland). pp 225-231 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Analytical calculations are performed to determine the radiation dose rate and total dose to the crew of a gas-core nuclear rocket from the fission fragments located throughout the plume volume. The rocket plume is generated by the products of the reactor and consists of hydrogen, uranium, and fission fragments. The mission chosen is a manned "courier" trip to the planet Mars. With the recent radiator-cooled concept of the gas-core nuclear rocket, round trip times to Mars can be as small as 80 days, starting with less than one million kilograms in Earth orbit. These fast trip times require a large number of megawatt hours of energy, and crew radiation dose is a function of the energy required for a mission. Four round trip times were picked in which the system was optimized so the initial vehicle mass in Earth orbit was minimized for each trip time. They are 80, 100, 150, and 200 days. The corresponding Earth orbit initial vehicle masses are 0.94, 0.64, 0.38, and 0.31 million kilograms. The radiation dose from the plume fission fragments to two crew locations of 100 and 200 meters from the nozzle exit is calculated. The doses are calculated assuming that there is a vacuum in the space between the crew and plume. 9 references. (auth)

8763 STATUS OF NUCLEAR LIGHT BULB ENGINE DESIGN AND PERFORMANCE ANALYSES. Bauer, H. E. (United Aircraft Research Labs., East Hartford, CT). pp 232-238 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Analytical studies were conducted to obtain information in the following areas: (1) steady-state performance characteristics of the reference nuclear light bulb engine, (2) dynamic response of the controlled engine to perturbations from steady-state operation, (3) control during start-up, steady-state operation and shutdown, and (4) problems associated with uprated engine designs. The dynamic response characteristics were calculated using finite-difference approximations to the time-dependent thermal, fluid dynamics and neutron kinetics equations. These equations were programmed on a UNIVAC 1108 digital computer to construct a dynamic simulation of the engine, with and without controls, at the nominal full-power operating condition. Results indicate that satisfactory control can be obtained by varying the fuel injection rate by means of a control valve which responds to the rate of change of neutron flux, or to the difference between the instantaneous and steady-state neutron fluxes. 10 references. (auth)

8764 INVESTIGATION OF AN R-F RADIANT ENERGY SOURCE WITH URANIUM HEXAFLUORIDE AND TUNGSTEN HEXAFLUORIDE INJECTION. Roman, W. C. (United Aircraft Research Labs., East Hartford, CT). pp 239-246 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

An experimental investigation was conducted using the UARL 1.2-MW r-f induction heater to simulate thermal environment and fuel region characteristics expected in nuclear light bulb reactors. The cylindrical test chamber in which the r-f gas discharge occurred was 5.7-cm in diameter and 14-cm long; it had a water-cooled fused silica peripheral wall and water-cooled copper end walls. Argon was injected at the ends of the test chamber to provide a radial-inflow vortex flow pattern. In some tests, simulated fuel consisting of a mixture of argon gas with either tungsten hexafluoride gas, uranium hexafluoride gas, or tungsten particles was injected into the discharge region from probes located at the centers of the end walls. All gases are exhausted from the test chamber through ducts located near the centers of the end walls. 9 references. (auth)

8765 OPTICAL TRANSMITTANCE OF FUSED SILICA DURING IRRADIATION PROCESSES. Palma, G. E.; Gagosz, R. M. (United Aircraft Research Labs., East Hartford, CT). pp 247-252 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The object of this investigation was the determination of the level of irradiation induced optical absorption and the resulting heat deposition in the fused silica transparent wall of a nuclear light bulb engine during normal operation. A direct determination of these quantities would require a source whose radiation flux and operating time were equal to that of the full-scale nuclear light bulb engine. Since a source of this type has not been available, a series of related experiments using available radiation sources, each of which simulates some aspect of the radiation flux or dose of the engine, has been conducted. These experiments include measurements of the optical transmission of fused silica at ambient and elevated temperatures during pulsed and steady-state reactor irradiation as well as steady-state 1.5 MeV electron irradiation. A comparison of the results of the reactor and electron experiments indicates that the generation of the optical absorption is due to ionizing effects and that the displacement effects due to neutrons do not contribute significantly. 11 references. (auth)

8766 OPTICAL TRANSMITTANCE OF FUSED SILICA AT ELEVATED TEMPERATURES DURING HIGH ENERGY ELECTRON BOMBARDMENT. Smith, A. B. (Lewis Research Center, Cleveland). pp 253-260 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

An experimental determination of the optical transmission of Corning 7940 UV and Suprasil I fused silica has been made. The LeRC dynamitron provided the equivalent ionizing radiation and

high temperature that the transparent gas divider of an operating nuclear light bulb engine would experience. The irradiation induced absorption was measured at 2150 Å, 2700 Å, and 4500 Å. The length of the irradiations was sufficient so that an equilibrium between radiation induced coloration and high temperature annealing was reached. The experimental results indicate a significant optical absorption, particularly at the shorter wavelength, which would make the use of fused silica in this concept questionable. 8 references. (auth)

8767 MINI-CAVITY PROBE REACTOR. Hyland, R. E. (Lewis Research Center, Cleveland). pp 261-268 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

The mini-cavity reactor is a rocket engine concept which combines the high specific impulse from a central gaseous fueled cavity (0.6 m diam) and NERVA type fuel elements in a driver region that is external to a moderator-reflector zone to produce a compact light weight reactor. The overall dimension including a pressure vessel that is located outside of the spherical reactor is approximately 1.21 m in diameter. Specific impulses up to 2000 sec are obtainable for 220 to 890 N of thrust with pressures less than 1000 atm. Powerplant weights including a radiator for [illegible] posing of the power in the driver region are between 4600 a[illegible] 32,000 kg—less than payloads of the shuttle. This reactor c[illegible] also be used as a test reactor for gas-core, MHD, breeding a[illegible] materials research. 16 references. (auth)

8768 EXPERIMENTAL FLOW STUDIES OF THE COLLOID CORE REACTOR CONCEPT. Turman, B. N.; Hasinger, S. H. (Aerospace Research Labs., Wright-Patterson AFB, OH). pp 269-275 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Results of experiments with highly loaded two component vortex flows are described, with solid to gas mass density ratios in excess of 100 : 1. The vortex chambers, with length to diameter ratios approaching unity, utilized end-wall injection as well as peripheral gas injection. The data are interpreted in terms of a rotating fluidized bed model, in which tangential gas injection rotates the powder bed, while the inflow gas velocity supports the bed against centrifugal force. These observations are extrapolated to consider basic operating principles for the colloid core reactor rocket engine concept. 8 references. (auth)

8769 TWO-PHASE VORTEX INVESTIGATION RELATED TO THE COLLOIDAL CORE NUCLEAR REACTOR. Lewellen, W. S.; Stickler, D. B.; Tam, C. K. W.; Cox, P. J.; Jones, P. W. (Massachusetts Inst. of Tech., Cambridge). pp 276-282 of 2nd Symposium on Uranium Plasmas: Research and Applications. New York; American Inst. of Aeronautics and Astronautics (1971).

From 2nd symposium on uranium plasmas: research and applications; Atlanta, Georgia, USA (15 Nov 1971). See CONF-711124-.

Liquid containment in a gas-driven vortex has been investigated both experimentally and theoretically. Average air-water mixture densities greater than 100 times the thru-flow gas density were contained in a vortex chamber while maintaining the loss rate of water at that due to vaporization. Interaction studies indicate a stronger coupling of the liquid to the gas than of the liquid to the wall. Results are discussed in terms of their applicability toward estimating the potential performance of a colloidal core nuclear reactor. 9 references. (auth)

8770 OTTO HAHN REACTOR WITH A SECOND CORE. Advances in Core Technology. Ulken, D. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomwirt., Atomtech.; 18: No. 5, 245-247(1973). (In German). (GKSS-73/E/19).

The nuclear energy research ship "Otto Hahn" covered 250,000 sea miles with its first core and so exceeded the guaranteed core life about 14%. Fuel was changed for the first time at the end of 1972. The removal and loading of the new charge was done without any complications, two days were necessary for each operation. The second core has certain improvements. These include instrumented corner elements with high-temperature thermocouples, two enriched zones with 3.5% and 6.6% ^{235}U respectively, cladding tubes of Zircaloy-4, finger absorber rods, a higher power density and hence a smaller core volume. It is also intended to operate as a test core for a reactor charge which could be used in a nuclear propelled demonstration ship. (GE)

8771 DIE KORVENTION UEBER DIE HAFTUNG DER INHABER VON ATOMSCHIFFEN VOM 23. Mai 1972. (Convention on the Liability of Operators of Nuclear Ships of 23 May 1972). Hoog, G. Frankfurt am Main; Metzner (1970). 205p.

The convention's origin and contents (i.e., definitions and liability regulations) as well as the regulations governing legal procedures are discussed in detail. Some special regulations, such as the access of nuclear ships to harbors and coastal and inland waters, are also reviewed. (GE)

Reactor Safety and Environmental Aspects

Refer also to abstracts 6478, 6489, 6498, 6499, 6568, 6569, 6911, 7082, 7140, 8634, 8638, 8697, 8712, 8713, and 8921.

8772 (CONF-730942-P5, pp vp Paper M 6/3) PROBABILITY OF CATASTROPHIC FAILURE OF REACTOR PRIMARY SYSTEM COMPONENTS. Holt, A. B. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Using recent information about failures in nuclear plants, the following estimates of the probability of failure events in prime piping systems of carbon and low-alloy steel were derived: (1) Severance prior to service: 5.7×10^{-4} events per plant; (2) Severance during service: 5×10^{-3} events per plant-year. The above numbers are higher, by one to two orders of magnitude, than the corresponding numbers used in calculations pertaining to nuclear safety. In order to estimate the probability of severance of a reactor vessel (which here includes the large nozzles), the logic of the Warner diagram is used. In the case of piping, it is noted that the ratio: Probability of severance prior to service/Probability of severance during ten years of service = 1 (approx.). (auth)

8773 (CONF-730942-P6B-S) STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY. Volume 6B. Supplement Volume. Preprints of 2nd International Conference, Berlin, Germany, September 10–14, 1973. Jaeger, T. A. (comp.). (Commission of the European Communities, Brussels (Belgium); Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1973. 403p. (In English and German).

Separate abstracts for 26 papers presented on structural mechanics in nuclear reactor technology are presented. (FS)

For abstracts of individual papers see: 6307, 6415–6418, 8636, 8774–8788, and 8953–8957.

8774 (CONF-730942-P6B-S, pp vp Paper J 1/5) DYNAMIC LOADS ON PRESSURE SUPPRESSION CONTAINMENTS. Koch, E. H.; Frenkel, E.; Siegers, L.; Weisshaeupl, H. A. (Kraftwerk Union AG, Frankfurt am Main). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In a Pressure Suppression Containment large quantities of steam may be condensed in a water pool, generally referred to as Wet-Well. The aspect of dynamic loading of the Wet-Well due to pressure suppression is discussed. In the past two years knowledge and understanding of this problem have increased substantially and a number of experimental programs in this area were performed. Dynamic loading of the Wet-Well results under two conditions: loss of coolant accident (LOCA)—pressure suppression and loss of main heat sink whereby the suppression pool is used for decay heat removal—pressure relief. For both cases one has to distinguish between two basically different phenomena: a transient phase where air is blown into the pool after the water has cleared the vent pipes and a steady state phase where only steam is carried down the vent pipes. In the case of the LOCA, the initial air carried out of the drywell volume might be quite large, causing the water level in the Wet-Well to rise after vent clearing. This level swell continues until the first air bubbles have traversed the distance between vent exit and water surface and escaped to the air volume of the Wet-Well. The transient phase ends when the air is purged from the drywell, at which time the water level has returned to normal and only steam flows through the vents at mass flow rates of 100 kg/m^2 sec or less. The level swell by the LOCA sets large masses of water in motion, resulting in pressure pulsations up to 0.5 bar at the bottom of the Wet-Well. The pressure oscillation of condensing and thereby collapsing steam bubbles are localized near the vent pipe exit; they are attenuated to a magnitude below 0.3 bar at the Wet-Well walls. In case of pressure relief the amount of air initially in the vent pipe is small, however the pressure transient due to the fast opening valves is very steep. The level rise in the pool is insignificant, but the air is expelled at much higher pressures. This results in pulsations due to the

oscillating air bubbles. In the course of a development effort in nozzles for pressure relief vents, it was shown that the dynamic pressure from air bubble oscillation can be kept below 1 bar and smooth condensation at high steam flow rates can be achieved up to the boiling point. Theoretical models have been developed for the effects contributing to dynamic loads. (auth)

8775 (CONF-730942-P6B-S, pp vp Paper J 1/6) PREDICTION OF RESPONSE OF THE COMPONENTS OF THE PS-CONTAINMENT TO THE FLUCTUATING PRESSURE FIELD IN THE PRESSURE SUPPRESSION POOL DURING BLOWDOWN. Appelt, K. D.; Kadlec, J. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of predicting dynamic response of components of a pressure suppression containment of boiling water reactors to fluctuating pressure forces induced by condensation of steam in the suppression chamber during blowdown is discussed. The potential risk of inception of detrimental vibration of the submerged structures in the suppression pool during blowdown is demonstrated on real precedents. The use of normal-mode approach with stochastic description of a random pressure field in the suppression pool is recommended as a means of solving the problem. To check the applicability of the proposed computation model and to obtain the first necessary information about the structure of the cross-spectral density function of the fluctuating pressure field in the suppression pool, extensive real-scale experimental investigations were proposed to be performed within the framework of blowdown tests on the pressure suppression system of the Marviken reactor in Sweden. For these investigations three instrumented panels with miniature pressure transducers for measurements of the pressure field and one elastic steel plate instrumented with strain gauges for the measurement of the dynamic response were installed in the suppression pool directly below the vent pipes. By the end of January 1973 nine measurements were performed of the pressure field and of the corresponding dynamic response. These measurements had been carried out during the blowdown tests with electrical preheated water in the reactor pressure vessel. Further tests are planned for the following three months. The results of these measurements as well as the comparison of measured and predicted dynamic response of the instrumented elastic plate are discussed. (auth)

8776 (CONF-730942-P6B-S, pp vp Paper J 2/3) STABILITY ANALYSIS OF THIN SHELLS WITH INITIAL IMPERFECTIONS. Huber, A. E. (Dynamik und Konstruktion GmbH, Loerrach, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problems of stability analysis of thin shells with initial deformations are outlined. Often initial imperfections are not known at the time of analysis. A solution method which uses the eigenvalue-stability analysis as an initial step in finding unfavorable imperfections is presented. The succeeding geometrically nonlinear deformation problem is reduced to an iterative application of equivalent linear problems. The influence of the initial imperfections on the critical load—for simply-curved shells (cylindrical) and multi-curves shells (here spherical)—will be demonstrated by the example of a containment shell. The containment deals with axi-symmetrical shells including nonaxi-symmetrical deformations which are calculated by means of Fourier analysis in circumferential direction. As a result of the problem it was shown that it is not the absolute size of the initial imperfections but their existence which mainly influences the critical load. (auth)

8777 (CONF-730942-P6B-S, pp vp Paper J 2/8) FIRST EXPERIENCES IN THE SAFETY ASSESSMENT OF CONTAINMENTS FOR FAST REACTORS IN THE FRG. Langhans, J. (Technische Ueberwachungs-Vereine eV, Cologne). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The layout and design of buildings containing sodium-cooled fast reactors are mainly determined by the consequences of possible disturbances in the reactor plant. Important aspects of the safety assessment relating to thermodynamic consequences of accidents and their influence on the integrity of the containment are dealt with only as far as they are specific for this kind of nuclear plants. The properties and the behavior of the coolant and for some of the plants the consideration of super-prompt-critical power excursions with a rupture of the primary system must be considered with LMFBRs. Examples of the work in safety assessment of the SNR-300 and KNK II are shown as far as possible. The following points are considered in respect to the loads on the reactor-containment and to its integrity which is a necessity for the retention of radioactive fission products: sodium leakages in rooms with inert-gas-atmosphere cause pressure rises and thermal loads on walls and ceilings as a result of heat transfer by convection and radiation; sodium fires have much higher energy release to the atmosphere so that increase of pressure is faster and more intensive as compared to sodium leakages in inert-gas-atmosphere; an exothermal reaction is possible if sodium, which is at a certain temperature, contacts insulation material to cause a temperature rise in surrounding components and a pressure rise of the atmosphere; liquid sodium in contact with cold concrete can increase the temperature of the concrete and at higher temperatures concrete will release its water, which can react with the sodium causing concrete to loose its integrity and the energy release accelerates the reaction; steam pipe ruptures may cause damage to sodium carrying pipes with an explosive sodium-water reaction and a dangerous hydrogen release; and superprompt critical power excursions with failure of the primary system must be considered for the SNR-300 for it is possible that the core will melt through the reactor tank and reach the external core-catcher and a part of the decay heat will be removed by the cooling system of the core-catcher with the rest transferred by natural convection to the concrete of the inner containment. Safety analysis must show that concrete temperatures and gas pressures in the inner containment do not exceed acceptable limits. (auth)

8778 (CONF-730942-P6B-S, pp vp Paper J 3/1) METHODS FOR ANALYZING LOADING CONDITIONS AND LIMIT LOAD STRUCTURAL BEHAVIOR OF NUCLEAR POWER PLANT BUILDING STRUCTURES IN THE EVENT OF EXCEPTIONAL EXTERNAL INFLUENCES AS AIRCRAFT CRASHES AND GAS PRESSURE WAVES. Dietrich, R.; Fuerste, W. (Fried. Krupp GmbH, Essen). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

If an aircraft crashed on the building structures of a nuclear power station, the walls would be subjected to a sudden loading. The loading depends to a great extent on the type of aircraft and the impact speed as well as on the shape and dimensions of the wall in question (flat slabs, spherical or cylindrical shell). In determining the optimum dimensions of the wall thicknesses for protecting the nuclear plant, sufficient attention must be paid to the problems resulting from these influences. In order to throw some light on the significance of some of these influences, the impact of a Boeing 707-320 and that of a Starfighter on chosen structures at various impact speeds were investigated. After determining the impact load–time–functions for the various impact speeds, a calculation procedure was applied by carrying out a dynamic analysis with an individual mass simulated system and a dynamic analysis using the Finite Element Method. In order to assess the loading on a building structure brought about by a gas pressure wave, a pressure–time–function based on the equivalent of TNT was determined. Applying this function together with the Finite Element Method a dynamic analysis was carried out. The results obtained by these investigations reveal the dynamic behavior of building structures subjected to such loads as well as the problems involved in dimensioning the wall thicknesses. (auth)

8779 (CONF-730942-P6B-S, pp vp Paper J 3/2) DYNAMIC LOADING OF A REACTOR BUILDING BY AIRPLANE CRASH. Lange, L.; Laue, H. (INTERATOM, Bensberg, Ger.). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Due to recent requirements of the licensing bodies an airplane crash is included in the design criteria for the reactor containment system. In order to achieve adequate dimensions for the reactor building the forces acting on it versus time (loading function) must be known during such an incident. A calculational model has been set up for analyzing the impact process of a deformable flying object on a rigid plane surface of the reactor building. The angle of impact on the target area can be chosen arbitrarily. For the description of the forces to the reactor building the aircraft is subdivided into a system of N coupled mass elements. The motion of the elements after the start of impact is characterized by their masses and the forces acting between them and is described by a system of ordinary differential equations which is solved numerically by a computer code. Besides translatory motions of the mass elements, also rotations are regarded in the case of non-normal impact. The coupling of the mass elements is obtained by considering the elastic plastic deformation properties of the various sections of the aircraft i.e. it is a function of the relative displacement of the masses. After fracture

has occurred the laws governing the coupling change. The forces between two masses are assumed now to be proportional to the square of the compression velocity and in addition are dependent on the product of the actual mean density and cross-section of the airplane. If during the compression the theoretical density of the mixed materials in a section is reached, the coupling forces are determined by the hydrodynamic compressibility of the materials. The transformation of kinetic energy into deformation energy during the compression process of the aircraft is obtained as the result of the analysis. The rotations of the flying object with respect to the target area for the case of a non-normal impact are also presented. The loading function, important to reactor building design, is given for various initial momentums of the aircraft. The components of the reaction forces normal and parallel to the target area are outlined as a function of the angle of impact. It is demonstrated that the design requirements for the reactor building due to aircraft impact can be significantly reduced by taking into account the deformation of the aircraft and the angle of impact. Assuming a nonrigid target would further decrease these requirements. (auth)

8780 (CONF-730942-P6B-S, pp vp Paper J 3/5) CALCULATIONS FOR REINFORCED CONCRETE STRUCTURES OF NUCLEAR POWER PLANTS SUBJECTED TO EXTREME DYNAMIC LOADS. Stangenberg, F. (Ruhr-Univ., Bochum, Ger.). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

For the design of structural members important for the safety of nuclear power plants, special requirements are demanded in the case of high emergency loads having a low probability of occurrence, such as blast forces, aircraft impact forces, jet forces of bursting pipes etc. Economic advantages concerning the design of construction members are obtained by taking into account the nonlinear material behavior of reinforced concrete up to a defined point of ultimate dynamic strength of material. This is true because by plastic deformations the capacity of energy absorption in general is improved and advantageous redistributions of stress in general are caused. Therefore it is useful to include these influences in the calculations of the dynamic stresses. Safety factors can be taken into account as load factors, as it is done with ultimate load analysis. Dynamic ultimate load calculations are discussed, mainly for reinforced concrete beams and plates. Starting from the corresponding differential equations, the calculations also include the rotational inertia of single beam or plate elements as well as the shear deformations. With actual structural dynamic problems in nuclear power plants, the shear behavior of reinforced concrete beams and plates is more important than usual, as is shown by examples. The finite propagation velocity of bending and shear waves are taken into account. The solution of the equations of motion are obtained by numerical integration by the use of finite time and space intervals. The calculations are performed using time dependent bending and shear laws for reinforced concrete up to the point of failure with realistic deformations. These latest scientific developments are of great significance for dynamic ultimate load analysis in practice. Elastic-plastic examples of application are compared with corresponding linear-elastic solutions. It is shown that the design of construction members based on elastic-plastic dynamic stress calculations in general is economically advantageous. This important conclusion is proven by numerical results. Also the relation to the approximation model of a one-degree-of-freedom dynamic system, including or excluding the plastic ductility of the structural member, is demonstrated. Finally, lumped-mass multidegree systems calculated by integrating numerically the corresponding equations of motion, briefly are dealt with. A nonlinear dynamic calculation of a foundation of a reactor building recently built is presented as an example for blast resistant analysis. (auth)

8781 (CONF-730942-P6B-S, pp vp Paper J 3/10) APPROXIMATE ANALYSIS OF THE RESPONSE OF A CHIMNEY TO A CRASH OF A MISSILE AGAINST IT. Reynen, J. (EURATOM, Ispra, Italy). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An approximate analysis of the response of a chimney to a crash of a missile against it is discussed. The local damage of the concrete at the point of incident is not taken into consideration, but rather the overall response, including plastic deformations at the base of the chimney according to a limit analysis approach. The safety philosophy in view of missiles admits stresses beyond the yielding point, provided that the chimney after being hit by a missile does not fall as a rigid mass on the reactor building. The analysis of the response of a structure on dynamic loads can be carried out in various ways. In the case of a crash of a missile against a chimney, whose design is based on criteria of buckling against gravity (and loads due to wind and earthquakes), it is obvious that the impact induces stresses beyond the yielding point. A realistic analysis takes into account plastic deformation. A limit analysis approach is adopted, searching for the amount of energy which can be absorbed by plastic deformation. The plastic energy which can be dissipated by the structure is to be compared with the energy transferred by the impact from the kinetic energy of the missile. Part of the kinetic energy of the missile is dissipated by plastic deformation of the missile itself, and only a fraction of it, depending on the impedance of the chimney (taking into account the point of incidence) is transferred to the chimney. It follows from these remarks that the most dangerous situation occurs when the missile hits the chimney near the top. In this case the response of the chimney, immediately after the crash, is accurately described by the first natural mode of vibration. The "zero" mode response i.e. a translation of the chimney, including foundation and surrounding earth, is hardly excited. When the chimney is hit near the base, the translation mode is excited more, but due to the big mass of the chimney as compared to the one of the reference missile, the resulting displacements and stresses remain smaller. (auth)
(auth)

8782 (CONF-730942-P6B-S, pp vp Paper K 1/6) RULES FOR ASEISMIC DESIGN IN AREAS OF RELATIVELY LOW EARTHQUAKE FREQUENCY AND INTENSITY. Koenig, G.; Zilch, K.; Hasse, E. (Ingenieursozietaet BGS, Frankfurt am Main). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Aseismic design of nuclear power plants seems to be necessary even in areas with relatively low seismicity. For these areas, however, it should be appropriate to use simplified methods. Considerations on the reliability of seismic design input data with regard to low seismic zones are given. It is necessary to develop a concept for the aseismic design as part of an overall safety concept. In addition, the uncertainties in design data should be taken into account. Some items of a proposed German standard on aseismic design of reinforced concrete members in nuclear power plants are discussed. (auth)

8783 (CONF-730942-P6B-S, pp vp Paper K 2/8) SOIL AMPLIFICATION AND SOIL-STRUCTURE INTERACTION STUDY FOR A NUCLEAR POWER PLANT IN SWITZERLAND. Furrer, H. (Motor-Columbus Ingenieur Unternehmung AG, Baden, Switzerland); Gaehler, K.; Jemielewski, J.; Hall, J. R. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A two phase study to assess soil amplification and soil-structure interaction effects for a nuclear power plant site in Switzerland is described. The reasons for the extensive study are explained. A brief description of the site follows. The geological and subsurface characteristics of the site are summarized using the results of an actually conducted field campaign. A brief review of the seismological conditions and a seismological risk evaluation is presented. The purpose of the first phase study was a general assessment of soil amplification effects by means of a harmonic motion analysis. Two selected types of reactor buildings, supported on a layer of sand-gravel, were subjected to steady state harmonic motions using variable frequency input at the rock level underneath. At the same time, for purpose of reference, both structures were considered hypothetically supported directly on rock and analyzed in the same manner. The evaluation of soil stiffness and damping parameters was based on in-situ measured shear wave velocities. These in-situ measurements are described briefly. The selected typical structures are presented as lumped parameter models supported on the sand-gravel layer and directly on rock. In the first case the values of the stiffness and damping elements were calculated, considering the fact that the depth of the sand-gravel layer is of the same order as the governing dimension in plan of the reactor building under consideration. A soil mass representation with two sets of springs and dashpots was used to represent both the effects of a response at the natural frequency of the soil layer as well as the governing free field effects for higher frequencies. In the second case, the rock was considered as elastic half space. The mathematical formulation of the problem and description of the harmonic motion analysis with variable frequencies are given. For each model the results are presented in a diagram, showing the response at a node located on the foundation mat. Each diagram contains two curves, one for the actual and the other for the reference model on rock, for the purpose of comparison. The purpose of the second phase study was to obtain the response spectra at the soil mass, which would take into account effects of soil amplification/attenuation and of the soil-structure interaction. This will present a basis for the structural design of buildings

and equipment of the planned nuclear power station. In order to achieve this a time history analysis using several selected digitized accelerograms was performed. It was necessary to modify the previously selected models due to project related changes and to include in the study a 150 meter concrete chimney. Otherwise the calculation of the lumped parameter models was performed in the same way as in the case of the first phase study. The actual analysis consisted of introducing the acceleration time histories at the rock surface as input and obtaining the transformed values at the soil mass. The normalized outputs were used to calculate the desired response spectra. The results are presented in form of tripartite logarithmic diagrams, showing clearly for the structures under consideration the amplification effects within a certain frequency range. The concluding remarks are devoted to the possible effects of the obtained results upon the design of the structures under consideration. (auth)

8784 (CONF-730942-P6B-S, pp vp Paper K 2/9) INFLUENCE OF THROUGH-SOIL COUPLING BETWEEN ADJACENT STRUCTURES ON SEISMIC RESPONSE OF NUCLEAR REACTORS. Lee, T. H.; Wesley, D. A. (Gulf General Atomic Co., San Diego, CA). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The theoretical investigations on soil-structure interaction during seismic disturbances in the past have been confined to single-structure configurations and the coupling through the soil with other massive structures nearby has not been considered. The increasing popularity of twin-plant nuclear power installations involving two or more independent containment structures built on separate base slabs has made it necessary for engineers to assess the effects of coupling between adjacent structures on the seismic loads in nuclear reactors. The interaction problem is treated by taking into account the influence of through-soil coupling and the theoretical formulation is based on a dynamic model in which several three-dimensional flexible structures, symmetric or unsymmetric, are bonded in close proximity to an elastic half space and simultaneously excited by the surface motion of the half-space. These structures are simulated by discretized linear systems which are allowed to be either similar or dissimilar. The superstructures are mounted on separate base slabs assumed to be rigid and of circular shape. The general equations derived are valid for a coupled configuration involving an arbitrary number of structures. Example problems discussed here are for a three-structure complex. The three-structure model consists of two identical structures simulating the twin reactor containment buildings and a third structure representing the turbine building, all structures being multi-mode. Steady-state frequency response was determined for each structure and the through-soil coupling effects on all modes are displayed. In addition to the response of the structural masses, the motion of the base slabs is also discussed. The separation distances between structures were varied so that non-equilateral spacing was included in the parameter variation studies. The numerical computations also cover different foundation media and different distribution of superstructure natural frequencies. Although the spatial variations of the earthquake motion is accounted for in the theoretical formulation, they were ignored in the computer analysis so that all structures are assumed to be subjected to the same disturbance. The inertia data used for the idealized nuclear power station correspond to those of a large HTGR. The important findings are that the seismic loads on reactor structures can be significantly altered by the coupling with adjacent structures when the plants are built on soil media and that seismic load reduction may be achieved through proper design and layout. (auth)

8785 (CONF-730942-P6B-S, pp vp Paper K 6/7) DESIGN DEVELOPMENT OF THE HTGR CORE AND ITS SUPPORT STRUCTURE: SEISMIC CONSIDERATIONS. Neylan, A. J. (Gulf General Atomic Co., San Diego, CA). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The development is discussed of the core support structure design from that employed on Fort St. Vrain to the large HTGR. Particular emphasis is given to the seismic considerations in design of the structure for the large HTGR. The overall configuration of each reactor type is critically compared. Although similar components are employed, the basic difference in layout configuration results in significant conceptual differences in the structural and mechanical requirements of the core support components. The configuration and major components for the large reactor are described in some detail. The essential features and function of components are discussed. The graphite components in the core support floor and permanent reflector are designed to form a tight array during reactor normal operating conditions. This composite structure resists compressive loading due to differential gas forces and concrete pressure vessel movement. This tight array concept has important advantageous effects on primary coolant flow distribution and seismic capability. The inherent requirements and methodology in developing a standard plant design for high seismic sites are presented. A design suitable for 0.15 g operating basis earthquake and 0.25 g safe shutdown earthquake has been developed which is applicable for over 80% of the expected sites in the U. S. A. The HTGR core and support structure consists of many thousand graphite elements. It behaves as an inelastic body having random response when subjected to seismic excitation. Simplified analytical models were developed to investigate this phenomenon. An overview of a test program to substantiate and correlate with the analytical models is provided. The program addresses the inter-element collision forces and frequencies of elements within the core and the load/deflection at the boundary. Various one-, two-, and three-dimensional scale models have been tested. A summary of the objectives of the program is provided. (auth)

8786 (CONF-730942-P6B-S, pp vp Paper K 6/9) AXISYMMETRIC REACTOR AND INTERNALS MODEL FOR SEISMIC ANALYSES. Tsui, E. Y. W. (General Electric Co., Sunnyvale, CA). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The major internal components of most nuclear reactors are beam-type structural elements, i.e., fuel rods, CRD tubes and housings, etc.; while the reactor pressure vessels, shrouds, internal supporting plates, etc., are shell elements. To conduct a 2-dimensional finite element dynamic analysis for the combined reactor and internal lumped mass system due to seismic excitations, it is a common practice to consider the cross-section of each element as rigid. One then can treat the shell elements as beams and the plates as springs, and the beam theory alone can be utilized to establish a mathematical model for the entire system. The advantage of this method of approach is that the element stiffness matrices for various types of beams are readily available and the system equations of motion can be formulated and solved in a straight-forward manner. The drawback of this procedure, however, is that for vessels of large radius to thickness ratios, the resulting dynamic properties are exclusively stiffer than those yielded by the shell theory, and hence the solution so obtained may not be appropriate. Another method of attack is introduced, namely, establishing the mathematical models essentially by the shell theory alone. This can be accomplished by transforming all the internal tubular beam elements into equivalent shell elements, using the orthotropic theory of elasticity with suitable modifications and the basic law of similarity between the actual beam and the transformed shell elements. Through the present technique, a mathematical model was established with which a dynamic analysis was conducted. It was found that this new method not only yielded satisfactory solutions for both $n = 0$ and $n = 1$ shell modes but also required minimum computer input preparations. The applicability of the present method of analysis is further significantly increased by the incorporation of the hydrodynamic mass matrices due to the fluid or liquid sodium contained within the reactor vessel. These effects can be efficiently taken care of by the introduction of the axisymmetric fluid finite elements. As a consequence of the appearance of the hydrodynamic mass matrices which have off-diagonal terms, however, it is desirable to solve the following eigen-value system equation: $Ax = \omega^2 Bx$ where A = positive definite system stiffness matrix, ω = circular frequencies, B = non-negative definite system mass matrix, x = eigen-vector. To ensure the dynamic behavior of the transformed shell elements is essentially identical to that of the beam elements, eigen-values and vectors of the transformed shell elements have been derived by the Rayleigh-Ritz variational principle and checked with those for uniform beams having the classical boundary conditions. (auth)

8787 (CONF-730942-P6B-S, pp vp Paper L 3/3) INTERACTION OF RATE AND HISTORY-DEPENDENT EFFECTS AND ITS SIGNIFICANCE FOR SLOW CYCLIC INELASTIC ANALYSIS AT ELEVATED TEMPERATURE. Krempl, E. (Rensselaer Polytechnic Inst., Troy, NY). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Life prediction for creep and low-cycle fatigue interaction and the analysis of ratcheting phenomena are of great importance in the design of future high-temperature nuclear reactors. These problems involve slow cyclic load application, inelastic deformation and are inherently nonlinear so that analytical closed form solutions are only possible in isolated cases. Fortunately, finite element computer programs with their time-following and nonlinear capabilities are now available for the efficient solution of

these complicated problems. The task is now to ensure that a proper representation of the material deformation behavior, the constitutive equation, is used in these computer programs. A qualitative comparison is made between the deformation behavior of metals observed in slow cyclic tests at high homologous temperature and the prediction obtained if various material idealizations (linear and nonlinear viscoelasticity, plasticity, creep theory, equation of state) are employed in the analytical simulation of the same experiments. A systematic study of the deformation behavior of metals exhibited in slow cyclic laboratory tests such as cyclic creep, cyclic relaxation, low-cycle fatigue with and without hold-time shows that rate- and history-dependent effects interact. Surprisingly, history dependence was found for repeated creep as well as relaxation tests. Because of the interaction of rate- and history-dependent effects, an additive use of elastic, plastic and creep strains is not realistic for cyclic conditions. Nonlinear viscoelasticity laws are incapable of reproducing history dependence and cannot be recommended for cyclic loading. It appears that a realistic constitutive equation for low-cycle fatigue creep interaction and ratcheting must be developed. Various possibilities of modeling the interaction of rate and history dependence are discussed. The concept of a nonfading or partially fading memory of discrete past events, such as the maximum stress tensor seen in the past, is introduced. A discontinuous growth law is specified for this parameter which can be incorporated into a nonlinear, differential or integral constitutive equation. (auth)

8788 (CONF-730942-P6B-S, pp vp Paper M 8/2) CONSIDERATIONS ON THE INFLUENCE OF FAILURE OF MECHANICAL COMPONENTS ON THE RELIABILITY OF NUCLEAR POWER PLANT SYSTEMS. Dressler, E.; Kafka, P. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

For estimating the risk of nuclear power plants, the reliability analysis of the various intermeshed systems is an important aid. In this respect, component failures which make the operation of engineered safeguards necessary or lead to a breakdown of such a safety system, have to be mainly considered. To be able to calculate the reliability of a system it is necessary to know the reliability data of all components of the system. For obtaining these data, there are principally two methods which can be applied in practice: to get to know the failure frequency distribution and the failure rate of a component, a number of identical components has to be watched under defined conditions and each failure has to be recorded. As the failure rates of components used in reactor systems are rather small, the number of the observed components and the observation time generally have to be very large. For some components, e.g. pipes, it is impossible to gain the statistical characteristics in the way described above, because investigations would require too many components of the same type for a too long time. So the reliability data of a component have to be calculated with respect to fabrication specifications and operation conditions. For this purpose design and quality control of components have to be considered as well as statistical investigations of similar samples under various conditions and empirical tests of the material which the components are made of. The problems mentioned above by means of quantitative reliability estimations of an actual emergency core cooling system are discussed. Especially the probability of ruptures of important pipes considering the stress and strength distributions and their influence on the reliability of the whole system are discussed. The aim is to modify evaluation methods based on the conventional structural mechanics by means of probability theory in order to make the reliability analysis a better and better tool for risk estimations of nuclear power plants. (auth)

8789 (COO-2152-11) INVESTIGATION OF PRESSURE DROPS AND HEAT TRANSFER COEFFICIENTS FOR LOSS OF COOLANT EVALUATION. Quarterly Progress Report for Period Ending March 31, 1974. Weisman, J. (Cincinnati Univ., Ohio (USA). Dept. of Chemical and Nuclear Engineering). 1974. Contract AT(11-1)-2152. 8p. Dep. NTIS $4.00.

Progress in experiments on pressure drop and heat transfer phenomena of interest for loss of coolant evaluations is reported. The experiments include transient pressure drop investigations, two-phase pressure drop and flow pattern studies, and transition boiling and reflooding heat transfer tests. (JWR)

8790 (HEDL-SA-663) ESTIMATION OF CRACK EXTENSION IN A PIPING ELBOW USING FRACTURE MECHANICS TECHNIQUES. James, L. A. (Westinghouse Hanford Co., Richland, Wash. (USA)). Nov 1973. Contract AT(45-1)-2170. 26p. (CONF-740606-8). Dep. NTIS $4.50.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

The extension of a hypothetical crack in a piping elbow under fatigue loadings at elevated temperature is estimated using the analysis techniques of linear-elastic fracture mechanics. The assumptions and approximations concerning the stress and loading conditions, expected in-service operational environment, and material property behavior that must be made in order to complete the analysis are discussed in detail. (auth)

8791 (INIS-mf-994) PRELIMINARY REMARKS ON EMERGENCY COOLING OF LWR. Cumo, M.; Farello, G. E.; Palazzi, G. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). [nd]. 28p. INIS.

From European two-phase flow group meeting; Brussels, Belgium (4 Jun 1973).

Fundamental aspects of the emergency cooling of L. W. R. cores after the loss of coolant accident were studied in the case of reflooding. A simplified experimental situation was realized with uniform and constant power injected in a tubular test section visualized at the outlet. Physical heat transfer models were provided, expressed in digital codes and the results were compared with the experimental data. (INIS)

8792 (KFK-1902) RESI-THESAURUS FOR THE REACTOR SAFETY INFORMATION SYSTEM. Eglin, W.; Krings, T.; Schultheiss, G. F. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Feb. 1974. 333p. (In German). Dep. NTIS (US Sales Only) $19.75.

In the development of the RESI-2 prototype system within the framework of a research project entitled "RESI, Reactor Safety Information System," a first approach toward a structured keyword index has been elaborated in the problem area of "Nuclear Licensing Procedure." The keyword index is used as an indexing aid in information processing and as a searching aid in the retrieval of information when operating the prototype system. The computer-aided RESI-2 system developed at the Institute of Reactor Development of Gesellschaft fuer Kernforschung mbH, Karlsruhe, uses the GOLEM program devised by Siemens which automatically compiles an alphabetic thesaurus both for the so-called bound descriptors (aspects) and for free descriptors. Structuring into subordinate terms and generic terms and the introduction of synonym crosslinks require a special processing step. The keyword index clearly shows the closely intermeshed and superimposed thesauri in the administrative and technical fields in the area of reactor safety and nuclear licensing procedures. (auth)

8793 (ORNL-TM-4505) LMFBR SAFETY AND CORE SYSTEMS PROGRAMS PROGRESS REPORT FOR OCTOBER–DECEMBER 1973. Fontana, M. H. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 121p. AT.

Activities and experiments at the FFM facility are described. The studies include temperature distributions and flow characteristics in partially blocked fuel channels, boiling detection, and reactor development. (JWR)

8794 (RT/ING-(73)17) CALCULATION OF FLAT STRUCTURES AND SHELLS FOR NUCLEAR PLANTS WITH A DIGITAL COMPUTER PROGRAM. Cesari, F.; Labanti, L.; Salvatori, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 29 Nov 1973. 181p. (In Italian). Dep. NTIS (US Sales Only) $12.25.

Elastic stress and deformation analysis of some structures used for nuclear plant containment is discussed. The three-dimensional finite-element code SAFE-3D in the version written for the IBM 360/75 computer is described. The structures are considered a metal cylinder, a metal cylinder with torispherical bottom, and a concrete compound structure for the auxiliary building of nuclear power plant. Some particular considerations on the use of the code are also presented. (auth)

8795 (WASH-1269, pp 273-309) GOVERNMENT REACTORS: MONITORING. Dec 1973.

In tritium control technology.

Monitoring and control of tritium at AEC-owned reactors are described. (TFD)

8796 (WASH-1269, pp 311-328) GOVERNMENT REACTORS: HANDLING AND CONTAINMENT. Dec 1973.

In tritium control technology.

Handling and containment of tritium at AEC-owned reactors are described. (TFD)

8797 (WASH-1269, pp 329-336) GOVERNMENT REACTORS: TRAPPING AND REMOVAL. Dec 1973.

In tritium control technology.

Trapping and removal of tritium at government-owned reactors are discussed. (TFD)

8798 ATOMIC ENERGY BRINGS NEW TYPES OF INSURANCE RISKS. Insurers Prepared for the Boom in Nuclear Power Plants. Handelsblatt; 28: No. 235, 15-16(Dec 1973). (In German).

The report on a colloquium concerning "Nuclear Power Plants–Technology and Insurance" demonstrates that with increasing power of a nuclear power plant unit the maximum probable loss increases rapidly also. (GE)

8799 PERSPECTIVE ON FUSION AND FISSION BREEDERS. Hafele, W. (Kernforschungszentrum, Karlsruhe, Ger.); Starr, C. J. Brit. Nucl. Energy Soc.; 13: No. 2, 131-139(Apr 1974).

Comparison of the beneficial features of the plutonium fast breeder and the tritium fusion breeder shows that both have similar potentials for meeting world energy needs for a very long time. Both systems are similarly insensitive to the cost of mined ore, with the abundance of lithium (the key fertile material for D-T fusion) being roughly four times the abundance of uranium. Comparison of the potential public risks associated with both concepts indicates important qualitative differences but many similarities in quantitative public risk magnitudes. The fast breeder power excursion which the fusion breeder avoids is shown to be of limited risk. In other respects the conception of the D-T fusion breeder with a Li blanket contained in niobium shows potential public risk similar to that of the Pu fast breeder. In view of the present system development issues of the plutonium fast breeder and the present feasibility issues of the tritium fusion breeder, it is believed that both should be pursued vigorously until all uncertainties are removed, so as to increase the eventual probability of having a completely acceptable breeder system. (auth)

8800 NUCLEAR POWER PLANT SAFETY. Otway, H. J. Int. At. Energy Agency Bull.; 16: No. 1/2, 72-77(1974).

In the last decade nuclear reactors have proven to be a source of electrical energy economically competitive with conventional means of power production. With the resulting increase in orders for nuclear power stations there has been a corresponding increase in public awareness of the safety and environmental aspects of these facilities. This public awareness has been evidenced by the number of articles in the world press, either praising or condemning the trend toward nuclear power. A discussion of large-scale accidents is presented. 9 references. (auth)

8801 PROGRESS IN THE ESTABLISHMENT OF THE REACTOR SAFETY INFORMATION SYSTEM RESI. Schlechtendahl, E. G.; Schultheiss, G. F. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 4, 9-14(1973). (In German).

The reactor safety information system RESI has been established in order to collect the information and complete set of data obtained so far in the course of the licensing procedure and is intended as a means to facilitate and speed up the process of reactor licensing. The data base will be available to all institutions participating in the licensing procedure. (GE)

8802 NUCLEAR POWER PLANTS IN COASTAL WATERS. Genscher, H. D. (Bundesministerium des Innern, Bonn). Umwelt; No. 26, 41-42(Oct 1973). (In German).

Reply of the Minister of the Interior of the German Federal Republic to the question whether German coastal waters are considered as possible sites for nuclear power plants. (GE)

8803 THIRD-PARTY LIABILITY INSURANCE FOR NUCLEAR FACILITIES. Mueller, W. (Allianz Versicherungs AG, Munich). pp 93-99 of Haftung fuer Anlagen der Energieversorgung. Boerner, B. (ed.). Dusseldorf; Verl. Handelsblatt (1973). (In German).

The implications of third-party liability insurance for nuclear installations are discussed. The liability for nuclear facilities only gives insurance protection in the case of actual nuclear hazards. (GE)

8804 PROBLEM OF WASTE HEAT USING NEW METHODS OF ENERGY PRODUCTION AS AN EXAMPLE OF HOW TO MASTER TECHNOLOGY. Hoecker, K. H. (Univ., Stuttgart). (1972). vp. (In German).

From international congress: environment; Stuttgart, Ger. (30 Jun 1972).

The development of technology, its effect on man's environment, the possible reducing of these effects and the social political significance of such causes are discussed. Nuclear technology greatly relieves air pollution. The radioactivity released in normal operation is only a fraction of the natural radioactivity. As regards the waste heat, at the beginning of reactor development, the light water reactors compared to the conventional power plants based on fossil fuels are at a disadvantage. Its efficiency is smaller, the waste heat to be carried off, greater. The disadvantages of the necessary liquid water for cooling and the upper limit of the operation temperature do not arise in HTGR reactors and breeders. The temperature is determined in this case by the turbine technique. Reactor and nuclear energy technology in connection with social, economical, environmental and educational problems, in particular engineering education, are discussed. (GE)

8805 EXAMINATION OF THE RELIABILITY OF DIFFERENT SCRAM SYSTEMS. Fehr, L. (Fachhochschule Giessen, Friedberg, Ger.). Atomwirt., Atomtech.; 19: No. 2, 77-79(Feb 1974). (In German).

Time patterns for scram systems for reliability of 6, 4, 2 and 1 tank systems are presented. (GE)

8806 ACOUSTICS DIAGNOSTICS AND NUCLEAR POWER PLANTS. Burton, E. J. (United Kingdom Atomic Energy Authority, Risley, Eng.). J. Brit. Nucl. Energy Soc.; 13: No. 2, 183-192(Apr 1974).

Diagnostic techniques in which remote sensors are used in association with modern data analysis techniques offer improvements in the availability and safety of nuclear power plants. Acoustic diagnostics are considered. The status of the techniques is briefly described and the possibilities are illustrated from applications drawn from reactor systems ranging from fast to thermal. (auth)

8807 SAFETY AND ENVIRONMENTAL PROTECTION REQUIREMENTS FOR LIGHT WATER NUCLEAR POWER REACTORS TO MEET CURRENT REGULATIONS IN THE USA. Richardson, J. A. (Burns and Roe, Inc., Oradell, NJ). J. Brit. Nucl. Energy Soc.; 13: No. 2, 149-171(Apr 1974).

The first of two reports reviewing current US safety requirements for light water reactors is presented. In it a detailed account is given of current US Atomic Energy Commission (USAEC) and National Environmental Policy Act (NEPA) rules and regulations, safety guides and regulatory guides applicable to light water nuclear power reactors. The environmental impact statement format now required since the 1971 Calvert Cliffs decision is fully described. (auth)

8808 SAFETY INSTRUMENTATION FOR THE SODIUM-COOLED FAST REACTOR. Hall, R. S. (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc.; 13: No. 2, 173-181(Apr 1974).

Safety problems of the fast reactor, and the role of instrumented protection in relation to the overall safety design of the reactor are outlined. The importance of the accident sequence arising from a fault within one sub-assembly is indicated, and the physical phenomena involved are discussed with regard to the generation of detectable signals. Several possible detection techniques for sub-assembly accidents are described, including those with detectors situated at the outlet of each sub-assembly, and also those involving whole-core parameters. The current status of these techniques is indicated, and where appropriate the steps necessary for their future application are specified. Reference is made to the way in which types of instrument would have to be combined to give a high degree of protection to the system, the actual protection required being dependent on the overall safety intentions. Attention is drawn to the problems of minimizing the spurious trip-rate for a well-instrumented reactor, which leads to stringent requirements on instrument reliability and/or replaceability. The possible role of the computer in handling the multiplicity of complex signals is mentioned, together with the problems that have to be solved before this can be done. It is concluded that satisfactory instrument protection is available for whole-core faults, but with regard to sub-assembly fault detection the situation is less clear. One can, at present, put forward some guidance on the instruments and their specifications, the justification and achievability of the latter is dependent on development work which is still proceeding. It may well be that uncertainties concerning the effects of the reactor environment will require that some of this work take the form of in-pile experiments. (auth)

8809 NUCLEAR POWER AND PUBLIC OPINION. Kathren, R. L. (Portland General Electric Co., OR). Health Phys.; 26: No. 6, 483-488(Jun 1974).

A public opinion survey initiated in Oregon prior to construction of the first privately owned commercial nuclear plant in the region showed that approximately half of the population favored the plant. Initially, about one-third of the public had no opinion, with about one in five expressing negative views. Both indecision and negative views decreased as plans for and construction progressed. Women and those with no college tended to be more indecisive in their views. In general, opposition to the reactor was based on nuclear or radiological safety concerns. Evaluation of the opinions of various subgroups as well as other public opinion studies sug-

gests how the health physicist can most effectively fulfill his role as an educator and public resource person. (auth)

8810 CONNAH'S QUAY. The Interaction of Nuclear Power and the Environment. Leslie, D. C. (Queen Mary Coll., London). Ann. Nucl. Sci. Eng.; No. 1, 11-20(Jan 1974).

The CEGB's proposal to build a nuclear power station at Connah's Quay in Flintshire is in conflict with the plan, now being considered by the Welsh office, to build a major new town on the left bank of the Dee. This conflict arises through the restraints on population which are imposed near nuclear power stations. Both the proposals which have been made for the development of the Dee estuary and the present policy for siting nuclear power stations are described. The nature of the conflict is clarified. The various methods of cooling power stations are explained since this was a subsidiary issue at the public enquiry into the CEGB's proposal. Finally an account is given of the enquiry and its outcome. (auth)

Reactor Theory and Calculation

Refer also to abstracts 8351, 8352, 8700, 8704, and 8737.

8811 (BARC/I-262) MURLI: A MULTIGROUP CODE FOR THERMAL REACTOR LATTICES. Huria, H. C. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 36p. INIS.

A method was developed to solve the Wigner-Seitz unit cell problem for thermal reactor lattices by multigroup multiregion collision probabilities techniques. A computer code based on this procedure is described. Along with the physical formulation of the code, generation of the associated cross-sections and the auxiliary program for data preparation are also discussed. Results of analyses of some heavy water as well as light water moderated single rod lattice measurements are presented. (auth)

8812 (IAEA-R-855-F, pp 24-50) THEORETICAL STUDIES OF POWER REACTOR NOISE. Kosaly, G. (ed.). Oct 1972.

Some problems of power reactor noise via a two point model of heat transfer and one point reactor theory were investigated. The reactor response to inlet temperature fluctuations was studied. It is shown that a peak which was predicted in the literature does not exist. The sink structure of the transfer function is examined in detail. The influence of inlet coolant temperature fluctuations and random mechanical vibrations of a control rod on the power spectral density of neutronic fluctuations was studied. Using a physically reasonable expression for the power spectral density of the vibrations of the control rod and some results obtained by Robinson for the inlet coolant temperature fluctuations, the interesting resonance like structure observed in experimental measurements of the power spectral density of the Oak Ridge Research Reactor (ORR) are explained. We obtain estimates of the root mean square temperature fluctuations and also data connected with the vibration of the control rod. The cross correlation function between coolant temperature fluctuations at two different axial positions is calculated. The behavior of the correlation function is explained for different values of the relevant parameters. (auth)

8813 (IAEA-R-855-F, pp 51-61) EXPERIMENTAL POWER-REACTOR NOISE STUDIES. Pallagi, D. (ed.). Oct 1972.

Power-reactor noise studies were carried out in this Institute since the mid-sixties. The initial aim of the measurements was to establish the power-noise spectrum of the WWR-S reactor under normal operational conditions. Later, investigations were centered mainly on the reliability of detecting bulk boiling by analysis of the noise deriving from core ionization chambers. The measuring arrangement and the results and conclusions drawn from these experiments are described. A recent problem to be tackled is the determination by cross-correlation method of the cooling water velocity in given channels of the reactor core. The measuring arrangement is described and the results obtained up to date are discussed. (auth)

8814 (TEF-943) THEORY OF A COMPOSITE LATTICE OF A NUCLEAR REACTOR. Galanin, A. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1972. 16p. (In Russian). INIS.

The theory of a composite nuclear reactor lattice is considered with the following assumptions: the distance between fuel rods is much greater than the neutron scattering length in the moderator and therefore it is possible to start from the diffusion approximation; the diffusion distribution of neutron flux extrapolated to the center of the rod does not depend on the azimuthal angle; the sources of thermal neutrons in a cell do not depend on the coordinates; neutron absorption in the moderator is slight; non-diffusion corrections are determined mainly by a given rod and can be calculated by solving the kinetic equation of a rod placed in a certain "approximating" cell with cylindrical symmetry; and thermalization effects can be taken into account by calculating the average cross-section for a rod placed in the cylindrical approximating cell. (tr-auth)

8815 (NIIAR-P-186) LANGUAGE OF THE SYSTEM FIKHAR. Zagatskii, B. A.; Zizin, M. N.; Temnoeva, T. A.; Yaroslavtseva, L. N. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Melekess (USSR)). 1973. 15p. (In Russian). INIS.

Language of the system FIKHAR is intended: (1) to formulate neutron physics problems of reactor design, (2) to derive information on neutron physics reactor design and (3) to describe inlet and exit interfaces of the calculation models. The language provides for entering the FIKHAR system within the framework of a text written in an entry language of the AL'FA system which is a subset of an ALGOL-60 language having a series of additional possibilities. Therefore the initial program in language of the FIKHAR system is first converted to AL'FA language, and then by means of the AL'FA translator to machine language. This study gives the student a strict presentation of the language of the FIKHAR system with presentation of syntax and semantics. In presenting the syntax, use is made of metalinguistic formulas. The system language also uses such ALGOL-60 language constructions as identifiers, numbers, etc. The first entry into the description is noted by stars at the ends, while the syntax and semantics are dropped. (tr-auth)

8816 (NIIAR-P-187) LIBRARY OF MODULES IN THE FIKHAR SYSTEM. Zizin, M. N.; Temnoeva, T. A.; Yaroslavtseva, L. N. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Melekess (USSR)). 1973. 12p. (In Russian). INIS.

A library of modules is described for the FIKHAR system consisting of calculated and control modules, and modules for summing and integrating. The structure of the modules is presented, and the demands assigned to the modules are described. The significance and purpose of various procedures of the FIKHAR system are described. The library of modules and procedures will later be enlarged and perfected. (tr-auth)

8817 (ORO-3443-48) SOLUTION OF PROBLEMS WITH INTERFACES AND SINGULARITIES. Babuska, I. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Apr 1974. Contract AT(40-1)-3443. 75p. (BN-789). Dep. NTIS $6.75.

Applications of the finite element method deal with the question of how to handle the singularities of the solution arising especially because of interfaces and unsmoothness of the domain. Global and local problems are investigated and include power reactor problems, problems of composite materials, biological studies related to the flow of electrical current in the brain, the diffusion of metabolics in the tissues, mechanics of fracture, and others. (MCW)

8818 FUNCTIONALS TO REPRESENT THE NEUTRON FLUX IN FAST PULSED ASSEMBLIES. Knickle, H. N. (Univ. of Rhode Island, Kingston); Daitch, P. B. Nucl. Sci. Eng.; 54: No. 2, 196-200(Jun 1974).

To investigate neutron flux time dependence in fast pulsed assemblies that have little or no regeneration, two semianalytic models have been developed and tested successfully against accurate but not transparent calculations. The models have been developed through the use of analytic time dependence and numerical space and energy dependence by the use of time moments. Comparison of the models has been made to exact two- and three-group diffusion theory. An interpretation of the parameters of the semi-analytic model has been given in terms of standard nuclear parameters. (auth)

8819 ESTIMATION OF REACTIVITY WORTHS BY LOCAL CALCULATION. Lineberry, M. J. (Argonne National Lab., Idaho Falls, ID). Nucl. Sci. Eng.; 54: No. 2, 157-165(Jun 1974).

Localized changes in a reacting system generally lead to a recomputation of neutronic behavior. The calculation involved can be simple (first-order perturbation theory applied for small changes), or complex (a complete system-wide recomputation for large alterations). Changes are considered in an isolated portion of a system, changes that are too large for accurate prediction using first-order perturbation theory. Unless the alteration is excessively large, the neutron distribution a few mean-free-paths from the altered region should change only slightly. Localized changes can be dealt with more simply by decoupling the altered region (including a buffer zone) from the rest of the system. The spatial magnitude of the recomputation can then be reduced, with concomitant savings in effort and cost. Variational methods are used to predict the shift in k to second order. As an additional bonus,

first-order estimates of the change in the flux and adjoint are calculated. (auth)

8820 APPLICATION OF AN IMPROVED TIME-DIFFERENCE METHOD FOR SPATIAL XENON TRANSIENT ANALYSIS. Lee, J. C. (Westinghouse Nuclear Energy Systems, Pittsburgh). Nucl. Sci. Eng.; 54: No. 2, 206-214(Jun 1974).

Application of a θ-difference technique to the finite-difference solution of xenon-induced spatial transients has been made, which shows a substantial improvement in the accuracy of the calculated stability index and oscillation period. Virtually no correction is necessary for time-step lengths up to two hours, so an accurate simulation of experimental tests can be performed explicitly in the time domain with fairly crude time-step lengths. A simple expression was obtained for the optimum value of the parameter, θ, that can minimize the calculational error for a broad range of the core stability. The method is expected to be applicable for controlled xenon transients as well as for free-running oscillations. (auth)

8821 SIMPLE METHOD FOR THE NUMERICAL INTEGRATION OF THE KINETIC EQUATION OF REACTORS WITH EXTERNAL SOURCE. Sapozhnikov, V. V.; Krylov, E. V. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 4, 13-15(1973). (In Russian).

The numerical integration of the point kinetic equation with neutron source is performed. Method is based on a matrix solution of the differential equation set. Numerical solution is compared with an analytical one. (auth)

8822 OPTIMIZATION OF HEAT REMOVAL IN A NUCLEAR-REACTOR CHANNEL AS A PROBLEM IN GAME THEORY. Ermakov, V. S.; Zaluzhnii, G. I. Sov. J. At. Energy (Engl. Transl.); 34: No. 3, 140-141(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 111(Feb. 1973). This is a summary of paper No. 645/6546 with full copy held by TIC.

An analytical investigation on the optimization of heat removal in a nuclear reactor channel using the methods of game theory is described. A cooperative bi-matrix game with arbitrary nonzero sum is chosen. The optimum strategies corresponding to optimizable variants in the reactor channel are illustrated. (JWR)

8823 FORMULATION OF BOUNDARY CONDITIONS IN THE METHOD OF SUBGROUPS. Nikolaev, M. N.; Usikov, D. A. Sov. J. At. Energy (Engl. Transl.); 34: No. 3, 141-142(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 112(Feb 1973). This is a summary of paper No. 646/6647 with full copy held by TIC.

General boundary conditions relevant to the "joining" conditions of subgroup fluxes of neutrons on the interfaces between media applicable to calculations of cells in heterogeneous lattices were discussed. The subgroup equations were derived in sequence from the kinetic equation in integral form. It was found that the central focus in the problem of subgroup boundary conditions was the treatment of correlations in the structure of the cross sections of those media the collisionless flight length between which is not negligibly short. In the case of a cell in a heterogeneous lattice, the correlations between the structure of cross sections of all media comprising the homogeneous zones of the lattice cell have to be taken into account. Two methods are proposed for the solution of this problem. (RWR)

8824 INCREASE OF INFORMATION CONTENT IN STUDYING FLUCTUATIONS OF NEUTRON DENSITY IN ZERO-POWER REACTORS. Bulavin, V. V.; Komissarov, L. V.; Lunin, G. L. (Inst. of Atomic Energy, Moscow). Kernenergie; 17: No. 2, 42-46(Feb 1974). (In German).

Various methods of studying neutron noise in a reactor at zero power level are analyzed with special respect to information obtained on physical reactor parameters from the data measured. Starting from this a method is proposed which is based on the measurement of analogies in the autocorrelation and cross correlation functions of two physically different detectors. The new method allows desired information to be obtained in one experiment only. Moreover, possibilities for generalizing the proposed method of measurement are discussed. (auth)

8825 DIFFUSION EQUATION AND CELL HOMOGENIZATION MADE RIGOROUS. Bonalumi, R. A. (CISE, Milan). Energ. Nucl. (Milan); 21: No. 4, 231-244(Apr 1974).

A new formulation is presented of the reactor equations, such as to allow a rigorous calculation of non-uniform reactor systems with the use of a diffusion theory formalism on homogenized cells. Each cell is characterized by two sets of unambiguously homogenized parameters: one set corresponds to the homogenization of the cell in a uniform lattice with a uniformly buckled source, the other gives response constants related to the injection of neutrons from the cell boundary into the source-free cell. Practical formulas are also given to evaluate some so far overlooked, leakage-related effects: it is shown that the appropriate diffusion area in a uniform lattice of heterogeneous cells is not the ratio of the diffusion coefficient to the absorption cross section. 8 references. (auth)

8826 PROFILING OF THE ENERGY RELEASE IN HETEROGENEOUS REACTORS. Ponomarev-Stepnoi, N. N.; Nosov, V. I.; Krutov, A. M. Jad. Energ.; 20: No. 2, 37-42(1974). (In Russian).

The profiling of the energy release of heterogeneous reactors was calculated for a given arrangement of the fuel elements by using the direct heterogeneous calculation method. The optimum arrangement of the fuel elements was accomplished by the method of most rapid descent. The experimental results on the study of the distribution of the energy release in the active zone of the reactor with a small number of fuel elements were reported. The radial-azimuthal distribution of the energy release was investigated in the fuel core of the elements. A comparison of the experimental and calculated results showed their good agreement. 9 references. (tr-auth)

8827 NEUTRON DRAG OF MOVING MEDIUM IN HIGH-FLOW PROFILED REACTORS. Kostritsa, A. A. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 65-67(1973). (In Russian).

The dependence of the neutron distribution and the fuel concentration on the flow rate of the coolant in reactors with constant energy release was found in the two-group approximation. It was shown that in the active zone near the boundary with reflectors a large variation in the fuel concentration is possible. (tr-auth)

Reactor Components and Accessories

Refer also to abstracts 7288 and 7421.

8828 (AECL-4607) RELIABILITY AND MAINTAINABILITY MANUAL: PROCESS SYSTEMS. Melvin, J. G.; Maxwell, R. B. (eds.). (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1974. 117p. Dep. NTIS (US Sales Only) $9.00. AECL $3.00.

Data and methods for designing reliability and maintainability into critical equipment are presented. It is aimed particularly at nuclear process systems. The concept of failure rate is introduced and leads into the basic mathematics of reliability. Typical equipment failure rates are tabulated. Other topics discussed are: Failure Mode and Effects analysis, Fault Tree analysis, reliability block diagrams, system availability, maintenance manpower, reliability testing, and specification requirements. (auth)

8829 (CONF-730942-P5) STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY. Volume 5. Structural Analysis and Design. Part M. Methods for Structural Analysis; Reliability Analysis. Preprints of 2nd International Conference, Berlin, Germany, September 10-14, 1973. Jaeger, T. A. (comp.). (Commission of the European Communities, Brussels (Belgium); Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1973. 506p. (In several languages).

Included are 41 papers on methods for stress and reliability analysis of structures and component materials. A separate abstract was prepared for each paper. (HDR)

For abstracts of individual papers see: 6393-6414, 8650, 8665, 8695, 8696, 8772, 8830-8840, and 8950-8952.

8830 (CONF-730942-P5, pp vp Paper M 1/1) STATUS REPORT ON INTEGRATED ANALYSIS METHODS FOR NUCLEAR REACTOR STRUCTURAL ANALYSIS. Swanson, J. A. (Swanson Analysis Systems, Inc., Elizabeth, PA). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The analysis of a nuclear reactor system as a total analysis task and the assumptions which are made in the separation of the analysis task into its component disciplines are examined. The structural analysis discipline is then examined in more detail to try to define a workable approach to an integrated structural analysis of the reactor system. The presentation starts with a general discussion of the total analysis task, from the initial concept of the reactor plant. The total task is then subdivided into the respective disciplines, and an attempt is made to rationalize or criticize the division into separate disciplines. The discipline of structural mechanics is then examined in view of its interactions with other disciplines such as fluid flow and

nuclear analysis to determine the degree of coupling which exists among these disciplines. This is done by examining the interactions of the state variables which apply at each point of the system. The state variables considered include fluence, temperature, displacement and pressure. The state variables defined are then used as the basis for the definition of an overall structural model of the reactor system. Such an overall model can be conceived in terms of the present status of analytical techniques, by use of such concepts as substructuring, constraint equations, coupled solutions for heat transfer, stress and dynamic analysis, along with fourth generation computer capabilities. A block design for an overall structural model is discussed and the areas which require new analysis techniques are discussed. The last section presents an outline of a mode of operation of a structural design/analysis activity which is established to implement a comprehensive integrated structural analysis of an entire reactor system. The concept of an evolving model of the system is presented and the coordination required to successfully manage such a design/analysis approach is discussed. A brief discussion of the effects of non-linear effects such as creep, plasticity, gaps on the overall approach is included. (auth)

8831 (CONF-730942-P5, pp vp Paper M 1/2) LARGE USER-ORIENTATED SYSTEMS OF PROGRAMS FOR STRUCTURAL ANALYSIS AND DESIGN. Jezernik, A.; Miller, M. C. (Central Electricity Generating Board, London). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The trend in the use of the structural analysis programs is towards larger, more integrated user-orientated systems. The main aim of organizing structural analysis systems of programs appears to be, to provide users with more versatile tools to reduce the required man-days and computing costs and to increase the scope and potential of the programs. A large modular system is described constituting the most widely used structural analysis packages developed by CEGB. The principal motivation in developing the system is to rationalize and simplify the considerable diversification of applications and techniques currently available. The applications encompass elastic, thermal, dynamic, creep and plastic analyses of arbitrary two-dimensional and three-dimensional structures. The system uses a standardized form of input for all applications and provides user-aides such as mesh generation, error facilities, output facilities (on-line and graphical) as integrated system modules. Calculational packages at present integrated into the system comprise FLHE-BERSAFE (thermal and elastic, two and three dimensions), TESS (creep and plasticity, two-dimensions), STAG21 (visco-elastic, two-dimensions). Various element types and a comprehensive selection of different solution techniques based mainly on finite element displacement model can be used in the analyses. All data presented to the system are in the form of files (datalists) stored on 3330 magnetic disks. A comprehensive permanent disk library containing thermal and mechanical properties of the most commonly used materials is available to all users. The system is designed to be "open-ended" in the sense that new sub-systems can easily be augmented. It is envisaged that these additions will include structural analysis applications which are strictly outside the area of finite element analysis, e.g. frameworks. The internal structure and mode of operation of the system are described in detail. Several diverse examples of nuclear design problems which have been studied are given. An examination and comparison with other large structural analysis systems currently available are given, together with a discussion of possible future developments in this field. (auth)

8832 (CONF-730942-P5, pp vp Paper M 2/2) ENGINEERING APPROACH TO FINITE ELEMENT ANALYSIS OF NUCLEAR COMPONENTS. Remedios, E. E. (Ontario Research Foundation, Sheridan Park); Bell, R.; Lovatt, J. D. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The practical aspects of three dimensional stressing of nuclear components to ASME Code III are discussed. The method of modelling and some typical analytical and experimental results are presented. General bounds on model complexity and computational costs are discussed. In general, the peak stresses of components with thick sections will be temperature dependent, whereas thin wall components will be more dependent upon earthquake loads. (auth)

8833 (CONF-730942-P5, pp vp Paper M 2/3) USE OF THE TITUS FINITE ELEMENT CODE FOR THE NUCLEAR STRUCTURES AND INTERNAL STRESS-ANALYSIS. Hasselin, G. (Societe d'Etudes Nucleaires et de Techniques Avancees, Courbevoie, France); Heliot, J.; Vouillon, C. 1973. (In French).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The TITUS code consists in a combination of finite element computer programs for thermo-elastic calculation. Some of the problems which have been worked out during the past few years with the TITUS code are described. Those problems have been chosen, on the one hand to show the different possibilities of the code, on the other hand to point out particularities and advantages in each field of application. The calculation of a water moderated reactor pressure vessel will be presented. In that case the structure has been divided into thin areas and thick areas. The first ones are calculated using the theory of shells of revolution and the second ones using the theory of solids of revolution. The TITUS code makes it possible to obtain directly results relating to the whole structure. The calculation of the bearing plates of a high temperature gas cooled reactor will be presented. These plants, which have to resist the weight of the reactor and the effect of a thermal gradient through their thickness, are lying on elastic supports. Two problems have to be taken into account: at first, stress analysis in the bearing plates, and then investigation of the elastic supports which become unloaded so as to change their localization till their loadings are equal for all operating conditions of the reactor. A special procedure of the TITUS code ensures the automatic investigation of the supports which become unloaded. The calculation of the bend of a pipe, used for circulating carbonic gas in a graphite moderated-gas cooled reactor, will be presented. The computer program allows to take into account the effects due to baffle plates and circumferential stiffness (baffle plates and stiffness are assumed to act like beams). The calculation of a prestressed concrete nuclear reactor vessel will be presented. Such a calculation requires the use of mesh generator programs and, owing to the great number of results to be obtained, the use of very elaborate analysis procedures. In the calculation the effects of the metallic components of the vessel and of its liner are taken into consideration. A calculation of heat conduction will be presented to show how the TITUS code enables to take into account the varied kinds of limit conditions in a very simple way. (auth)

8834 (CONF-730942-P5, pp vp Paper M 4/5) FINITE ELEMENT MESH GENERATION PROGRAM FOR ARBITRARY TWO- AND THREE-DIMENSIONAL STRUCTURES. Neale, B. K. (Central Electricity Generating Board, Berkeley, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The general mesh generation program BERGEN was conceived to meet an increasing demand to analyze the complex engineering structures associated with nuclear plant design. Two-dimensional mesh generation programs have been previously developed for axi-symmetric structures using isoparametric mapping techniques. The program described extends the mapping technique to produce three-dimensional meshes for non-axisymmetric structures. The basic assumption of the program is that an arbitrary structure can be thought of as an assemblage of discrete macroblocks. For convenience the shape of the macroblock is taken to be quadrilateral for two-dimensional structures and hexahedral for three-dimensional structures. In each case the macroblock can have sides or surfaces which vary in a linear, quadratic or cubic manner. By specifying selected nodal co-ordinates on the boundaries of the macroblocks and employing the isoparametric mapping technique the quadrilaterals and hexahedrals are transformed into a unit square and a unit cube respectively. Knowing the number of elements and the element type in a macroblock, interpolation of the scaled macroblock is performed and related to the actual macroblock in order to determine the intermediate nodal co-ordinates. To provide for non-uniform meshes the interpolation of the scaled macroblock can vary in a linear, quadratic or any ordered manner. The element topology for each macroblock is deduced from prior knowledge of the element type and the number of elements comprising the mesh. An automatic facility is included in the program to join macroblocks at a common edge or surface. With careful discretisation of a structure into macroblocks a complete mesh can be generated using most of the finite elements available in the BERSAFE system of structural analysis. Examples are given for two- and three-dimensional problems showing the capabilities of the program. The time taken to produce the mesh for the complex bifurcation joint and to complete a finite element stress analysis run took less than one working week. By existing methods the time taken by an experienced user would have been well in excess of four weeks. (auth)

8835 (CONF-730942-P5, pp vp Paper M 5/4) ENERGY METHOD FOR THE TRI-AXIAL ANALYSIS OF A RECTANGULAR SLAB WITH A CENTRAL HOLE AND ARBITRARY BOUNDARY CONDITIONS. Lundsager, P. (Danish Atomic Energy Commission, Risoe). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The term "energy method", in case of complicated analysis, in most cases means the finite element method. Other energy methods, such as the Rayleigh-Ritz method, are more often used for simpler analysis, an important field being verification for the complicated methods. One main difficulty in connection with the Rayleigh-Ritz method is to find admissible functions for expansion of the solutions. Hence the application of this and related methods have been restricted to cases with very simple kinematic boundary conditions. The present method overcomes these difficulties by spring suspensions on surfaces, where kinematic boundary conditions are prescribed: The rectangular slab is supported by springs on the vertical edges and loaded by uniform pressure on the upper surface. The hole is elliptic, running vertical in the center of the slab. The displacement field is approximated by a truncated series in powers of the independent variables, so that arbitrary displacements can be represented on the boundaries. By prestressing of the springs, displacements or stresses (depending on the spring stiffnesses) can be prescribed. The coefficients in the expansion are determined by the Rayleigh-Ritz method, the elastic energy of the springs being added to the energy of the slab. The prestressing of the springs enters the computations as coefficients in an expansion similar to that of the displacements. Examples on solutions are shown. The present study is a part of the investigation of the thick, perforated bottom slab in a PCRV. The slab considered forms an element of the bottom slab. (auth)

8836 (CONF-730942-P5, pp vp Paper M 5/7) BUCKLING OF DEEP SHELLS. Batoz, J. L.; Dhatt, G. (Univ. Laval, Quebec). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A finite element formulation is presented to study pre- and post-buckling behavior of deep thin shells undergoing large displacements. The Newton-Raphson method is employed to solve the nonlinear system of equations. The nonlinear strain displacement relations are based on the deep shell theory. The material properties are assumed linear. A new method has been presented to initialize the unsymmetrical bifurcation paths for symmetrically loaded structures. This is achieved by introducing a small unsymmetrical load perturbation (0.1% of real load) over the symmetrical structure. If an unsymmetrical state exists nearby, the Newton-Raphson method will converge to that point. The complete path is then traced in a routine manner. Illustrative examples include arbitrary deep shells (spherical, cylindrical) under various load and boundary conditions. The displacement and stresses during the pre- and post-buckling states are studied in details. Wherever possible, these results are compared with those obtained by other investigators. The unsymmetrical bifurcation paths are also traced for a number of shells. (auth)

8837 (CONF-730942-P5, pp vp Paper M 6/2) MICROSTRUCTURES AND RELIABILITY OF STRUCTURES. Pellissier, G. E. (RRC International, Inc., Troy, NY); Fleischmann, W. L. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

It is becoming increasingly evident that the reliability of structures is influenced by the microstructures of the materials comprising the structures to a greater degree than has been generally assumed in the design of equipment for nuclear power plants. Two major categories of abnormal microstructures, namely, those in the bulk material, and those associated mainly with the surface are discussed. In the first group, examples will be given of certain microstructures resulting from processing, heat treatment, welding and service that adversely affect strength, toughness, and/or corrosion resistance. In the second group, microscopic surface characteristics will be considered in the context of surface integrity, that is, the description and control of physical and metallurgical surface microdefects that may be created by machining, grinding, forming, heat treating and cleaning. It will be recognized that the nature of these microscopic irregularities implies the need for close control of manufacturing, fabrication, and repair procedures. But it also will be pointed out that materials used in critical applications must possess considerable "built-in" resistance to a certain amount of unavoidable "abuse", so as to allow for reasonable latitude in processing and fabrication parameters, and for repair welding, without serious impairment of the material performance characteristics. Finally, means of effectively utilizing information about microstructural abnormalities, to improve performance and maintainability of structures will be considered. (auth)

8838 (CONF-730942-P5, pp vp Paper M 6/5) ASSESSMENT OF ACTUAL LOADING CONDITIONS OF STEAM GENERATORS AND HEAT EXCHANGERS ACCORDING TO PROBABILISTIC CRITERIA. Beckmann, G.; Fritz, K. (Waagner-Biro AG, Vienna). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A new procedure for the assessment according to actual loading conditions, e.g., by the application of probabilistic criteria, is proposed which can be used for heat exchangers and steam generators. It is characterized by the following features: (a) In a series of thermal performance computations the effects of deviations of the relevant input data like operating conditions, geometry, etc. on the load determining factors pressure and temperature are calculated. (b) For each case the relative deviations of the load determining factors are transformed into deviations of the variables to be assessed (e.g., in the case of tube into deviations of the required wall thickness); particular care has to be taken for the distinction between correlated and uncorrelated effects. (c) The single effects according to (b) are superposed, beginning with the correlated ones; for this superposition the relevant rules have been developed. In this step the probabilistic character of the individual factors can be taken into account by the use of mean values and standard deviations for the input data, yielding the resulting design characteristics in similar form. With this new probabilistic method the design of steam generators and heat exchangers can be accomplished to the high reliability standards required in nuclear power stations. (auth)

8839 (CONF-730942-P5, pp vp Paper M 7/2) PROBABILISTIC PREDICTION OF MULTIPLE FRACTURE UNDER SERVICE CONDITIONS. Chopra, P. S. (Argonne National Lab., IL); Wang, P. Y.; Hartz, B. J. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of multiple fracture propagation configurations in structures under service conditions is examined. This is accomplished by introducing a generalized energy criterion for multiple brittle fracture in nonhomogeneous and anisotropic materials. The fracture criterion is expressed in terms of the so-called Hartz function, H, which measures the difference between the total instantaneous strain energy release rate, G_T, and the rate at which energy is required for the formation of new fracture surfaces, R_T. Strain energy release rates are computed for a variety of symmetric as well as asymmetric fracture propagation configurations from finite element solutions of incrementally related boundary value problems. These solutions yield a deterministic influence parameter, α, which is used to relate the applied loading to the probabilistic expression for the strain energy release rate. A similar treatment is given to the function, R_T, for which the influence parameter, β, must be determined experimentally. The parameters, α and β, depend upon the relative locations, sizes and orientations of the primary and secondary cracks as well as flaws, and secondary imperfections present in the material. In addition, the parameter, β, depends upon the relative values of the specific surface energy associated with the possible primary and secondary fracture paths. This is important for anisotropic materials such as ceramics, mixed-oxide fuels and concrete, and for materials experiencing stress-corrosion fracture, where the energies associated with intergranular and transgranular fracture, for example, may differ significantly. From the probabilistic expressions for G_T and R_T, the Hartz function is determined as a random variable, h, which describes the multiple fracture process. The formulations developed in this presentation are applied to a single edge notched panel experiencing multiple fracture under assumed random loadings. Some interesting symmetric as well as nonsymmetric fracture configurations are studied and the results are related to reported experimental observations. (auth)

8840 (CONF-730942-P5, pp vp Paper M 7/9) COMPUTER PREDICTION OF FATIGUE CRACK PROPAGATION UNDER RANDOM LOADING. Miyamoto, H.; Fukuda, S. (Tokyo Univ.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The results of two simulations on fatigue crack propagation under random loading are presented. First, fatigue crack propagation under random loading is simulated based on linear fracture mechanics. From the results of axial load tests on double symmetric V-notched steel sheet specimens, fatigue crack growth rate $d(2a)/dN$ may be expressed in the form, $d(2a)/dN = C\Delta K^4$ ($\Delta K > \Delta Kth$) and $d(2a)/dN = 0$ ($\Delta K \leq \Delta Kth$), where C is a log-normally distributed random variable and ΔK_{th} is the threshold stress intensity factor range below which cracks are considered to be non-propagating from the practical point of view. The procedure of simulation is obtained by reducing the present problem

to that of obtaining the output response of non-linear zero-memory system with feedback loop to random noise signal. Random loads with desired power spectral density are obtained by passing digitally generated white noise through numerical filters. As the increment of crack length at Nth cycle is determined by the stress intensity factor range at that cycle, which is proportional to the product of the stress range at Nth cycle and the square root of half the crack length at (N-1)th cycle, if we introduce the concept of ΔK_{th}, the effect of the sequence of load cycles can not be neglected. The advantage of numerical filter technique is in that the effect of loading sequence can be included into the analysis. The numerical and experimental results are compared for narrow band random loading, which type of loading is closely related with random load fatigue of components of gas cooled reactors. Both results agree well except for very short cracks. Second, elastoplastic response at the crack tip is considered by the introduction of finite element method and fatigue crack propagation under random loading is simulated incorporating the effect of memory of prior load history. In the calculation, it is assumed that when the total absorbed hysteresis energy of elements equals a postulated critical value U^*, separation occurs and the crack extends to the next element. Here, only numerical results are given for aluminum alloys, but the method is applicable to any kind of material. (auth)

8841 (CONF-730942-P6A-S) STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY. Volume 6A. Supplement Volume. Preprints of 2nd International Conference, Berlin, Germany, September 10–14, 1973. Jaeger, T. A. (comp.). (Commission of the European Communities, Brussels (Belgium); Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1973. 378p. (In Several Languages).

Information is presented concerning stresses and vibrations in reactor components such as fuel assemblies, heat exchangers, piping systems, and pressure vessels. Separate abstracts are included for 21 of the 28 papers presented. Seven of the papers have previously been abstracted and included in NSA. These seven papers can be located in NSA Vol. 29 under the following abstract numbers: 4452, 4469, 4482, 4493, 4495, 4497, and 4502. (DCC)

For abstracts of individual papers see: 7421, 8635, 8651, 8666, 8697, 8842–8855, 8889, and 8890.

8842 (CONF-730942-P6A-S, pp vp Paper F 3/2) PROBLEMS OCCURRING IN NUCLEAR PIPING SYSTEM ANALYSIS AND OPERATION. Landers, D. F. (Teledyne Materials Research, Waltham, MA). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the analysis area the new design criteria (i.e., ANSI-B31.7 and ASME BPVC SC III) have imposed heavy burdens on the standard piping design organizations. These can be divided into two distinct categories: lack of manpower; and inadequacies in the area of stress analysis. The first item will be discussed with respect to the relative differences between staffing and cost requirements for an ANSI-B31.1 plant and an ASME BPVC SC III plant. The second item will discuss the new knowledge and expertise which must be brought to bear in performing piping analysis to the new criteria. Areas discussed will be calculation of temperature distribution, understanding stress indices and what they represent, seismic analysis, force-time history analysis, and fatigue evaluation. This discussion will not deal with the analytical derivations of the solutions to these problems but rather with the impact of these requirements on the piping industry and the necessity for the piping designer to be knowledgeable in these areas. 4 references. (auth)

8843 (CONF-730942-P6A-S, pp vp Paper F 6/6) COMPUTER CODES FOR THE CALCULATION OF THE FREQUENCY RESPONSE AND TIME BEHAVIOR OF SHELL-AND-TUBE TYPE COUNTERFLOW HEAT EXCHANGERS WITH RESPECT TO PRIMARY AND SECONDARY INLET TEMPERATURE AND MASS FLOW PERTURBATIONS (TUMHEX IN COMBINATION WITH FRETI). Hoeld, A. (Technische Univ., Munich). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A digital code, named TUMHEX, will be presented which is based on a linear analytical one-dimensional model calculating the frequency response behavior of coolant temperature and/or coolant mass flow on both (primary and secondary) outlet sides of a counterflow shell-and-tube type heat exchanger with respect to perturbations in the corresponding temperature and mass flow parameters at the inlet to the primary and/or secondary side, respectively. To make the heat exchanger model as comprehensive as possible, mass-flow dependent heat transfer coefficients, an exact solution of the heat conduction through the tube walls and (at least with respect to the coolant mass flow rates) temperature-dependent coolant densities had been taken into account. TUMHEX has been tested against frequency response measurements on an industrial-size heat exchanger and has shown good results. An auxiliary program FRETI which permits a retransformation from the frequency into the time domain in a numerical way will enable to calculate from given frequency response curves the time response behavior of important heat exchanger parameters against both step and/or any system perturbing signals. 8 references. (auth)

8844 (CONF-730942-P6A-S, pp vp Paper G 2/5a) FINITE ELEMENT SOLUTION OF NORMALLY INTERSECTING CYLINDERS. Bakhrebah, S. A.; Paul, S. L.; Schnobrich, W. C. (Univ. of Illinois, Urbana). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A finite element solution of the problem of stress distribution in the vicinity of thin elastic normally intersecting cylinders subjected to internal pressure is presented. A reasonable solution of the cylinder-to-cylinder intersection problem can be achieved by a realistic representation of the intersection region, i.e., three-dimensional elements where three-dimensional behavior dominates, and curved shell elements where shell behavior dominates. It will be shown that the use of curved shell elements obviates the need for using an inordinately large number of elements to obtain good solutions to the problem. The mesh is graded in such a way as to increase the number of elements in regions of sharp stress gradient. Incidentally, the finite element model employed here avoids the difficulty of defining a shell normal along the intersection curve which is encountered when flat plate or shell elements are used in the intersection region. An alternative approach to avoiding the "parasitic" shear inherent in the original Ahmad's element through the artifice of incompatible displacement modes is presented. 11 references. (auth)

8845 (CONF-730942-P6A-S, pp vp Paper G 3/5) DETERMINATION OF FRACTURE MECHANICS DATA IN THE ELASTIC–PLASTIC RANGE OF MATERIALS. Seidl, W. (AEG-Telefunken, Frankfurt am Main). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An experimental investigation aimed at analyzing the fracture of steel in the temperature range of transition from frangible to non-frangible behavior is presented. Samples provided with artificially initiated cracks were used to study the dependence of fracture stress on the geometry of the cracks and of the samples investigated. Experimental values were determined of the critical stress intensity factor K_Q, the critical crack opening stretch, COS, and the integral work done by plastic deformation at the crack tip, J. Furthermore the crack extension resistance, R, was determined in dependence of the effective crack length which includes the increase in size of the plastic zone. A comparison was performed of the values thus determined in order to find a criterion that is best suited for assessment of the possibility of the occurrence of fracture in the brittle-ductile transition region. 8 references. (auth)

8846 (CONF-730942-P6A-S, pp vp Paper G 4/6) STUDIES BY SCALE MODELS OF CRACK EFFECTS ON PRESSURE VESSELS. Dore, A.; Foglia, S.; Lebey, J.; Tomachevsky, E. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An in-similitude testing study has been performed with pressure vessels to show the influence of the various parameters occurring in the damage process such as: defect length growing, and defect breadth growing as function of the membrane stress and this for different initial dimensions. The defects have been milled in full thickness of the vessel wall, sharpened on the ends and slaked with a local internal skin. At the same time the crack growth law is verified. All these tests are made under static stresses and also under cyclic stresses. 4 references. (auth)

8847 (CONF-730942-P6A-S, pp vp Paper G 5/6) APPLICATION OF THE FINITE ELEMENT METHOD FOR THE SAFETY EVALUATION OF REACTOR COMPONENTS. Miksch, M.; Schmitt, W. (Kraftwerk Union, Erlangen, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The finite element method is not only a powerful tool for the calculation of stresses and displacements in any structural component, but it is as well very useful for discussing several simple analytical methods. This will be shown by two examples: calculation of hoop stresses due to temperature changes in a long

hollow cylinder (Young's modulus E and coefficient of thermal expansion α are temperature-dependent); and calculation of the leakage area in a nuclear pressure vessel. 2 references. (auth)

8848 (CONF-730942-P6A-S, pp vp Paper G 6/3) USE OF ACOUSTIC EMISSION FOR QUALITY ASSURANCE OF PRESSURE CONTAINMENT STRUCTURES. Green, A.; Morais, C. (Acoustic Emission Tech. Corp., San Ramon, CA). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Acoustic emission data acquired from nuclear reactor pressure vessel tests and experimental programs on other smaller pressure vessels are presented and discussed. An orderly description of the advantages and disadvantages of acoustic emission testing is presented. Particular attention is given to the instrumentation used and its importance as to requirements necessary to be able to compare results obtained by others are discussed. The usefulness of spectral analysis and amplitude distribution is described. Actual data acquired during pressure vessel tests, ranging from thick wall nuclear vessels to thin wall aerospace vessels, metallic, nonmetallic, and glass are shown. From a quality assurance viewpoint, multi-channel real-time acoustic emission source location system requirements are reviewed and evaluated. In particular the interplay between the material and the emission is discussed. Finally the use of acoustic emission techniques during the welding fabrication of pressure vessels and other structures is shown to be an extremely useful tool. 17 references. (auth)

8849 (CONF-730942-P6A-S, pp vp Paper H 1/5) DEFORMATION BEHAVIOR OF CONCRETE SPECIMENS FOR PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS: LOAD APPLICATION AIMING AT UNIFORM STRESS DISTRIBUTION OR AT UNIFORM DISTRIBUTION? Schickert, G. (Bundesanstalt fuer Materialpruefung, Berlin). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In prestressed concrete reactor pressure vessels concrete is stressed multi-axially. Fundamental data for the different methods of calculation and for safety of prestressed concrete reactor pressure vessels are being provided by investigations by several research institutes on the multiaxial strength of concrete. In this connection it must be stated that the relevant test results are considerably influenced by different methods of load application to the concrete specimens. A number of published test methods are compared with each other. This shows that size and shape of the specimens used for the experiments were rather different. In particular an account is given of BAM tests with 10 cm concrete cubes where load has been applied by means of rigid steel platens, with interlayers of lubricated aluminum sheets and by brush bearing platens. In these uniaxial tests the deformation of the specimens was registered up to failure. 20 references. (auth)

8850 (CONF-730942-P6A-S, pp vp Paper H 2/1) SIMPLE APPROXIMATE METHOD FOR THE ANALYSIS OF THE ULTIMATE CARRYING CAPACITY OF PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Huber, A. E.; Hofmann, H. H. (Dynamik und Konstruktion GmbH, Loerrach, Ger.). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An approximate method for the failure analysis of PCRV's based on finite element techniques is presented. An iterative solution scheme is used which will be demonstrated by an example. Through the iteration process areas with one, two and three crack directions have been determined. For the reinforcement and prestressing tendons the real stress-strain behavior was used. (auth)

8851 (CONF-730942-P6A-S, pp vp Paper H 2/2) BEHAVIOR OF PCPV's UNDER ULTIMATE LOAD CONDITIONS AND ITS INFLUENCE ON CALCULATION AND DESIGN (ESPECIALLY APPLIED TO THE THTR-VESSEL). Bindseil, P. (Fried. Krupp GmbH, Essen). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Information is presented on some recent work on ultimate load analysis of prestressed concrete pressure vessels, showing the combination of one of the conventional methods with advanced finite element methods and its application to practical design. Moreover some problems of the integrity of the liner in dependence on the vessel behavior will be discussed. A short summary of the calculation method used in the THTR-vessel analysis will show the effect of the chosen safety-criteria on the practical design. 11 references. (auth)

8852 (CONF-730942-P6A-S, pp vp Paper H 3/5) SYSTEM ANALYTIC AND PARAMETRIC STUDIES OF PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Schnellenbach, G.; Hartmann, G.; Ick, U. (Ruhr-Univ., Bochum, Ger.). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The arrangement and the location of heat exchangers play a decisive role in determining the form and size of PCPVs and influences at the same time the size of the reactor building as well. The integrated arrangement of heat exchangers inside the vessel or inside the wall, respectively, is compared with the nonintegrated system. Advantages and disadvantages of the different systems are discussed. The studies deal with the economical and technical optimum layout of the vessel and also take into account the demands placed on the reactor building. Measures of safeguarding against internal and external influences are discussed in this context. 6 references. (auth)

8853 (CONF-730942-P6A-S, pp vp Paper H 3/10) DESIGN AND STRESS ANALYSIS OF A PREFABRICATED PRESTRESSED CONCRETE PRESSURE VESSEL. Fruehauf, H. (Hochtief AG, Frankfurt am Main); Meerwald, K.; Naehrig, T. 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A design of a prestressed PCRPV which led to the "multi-shellsystem Hochtief" is presented. It incorporates prefabrication techniques. The cylindrical wall consists of concentric ring-elements which again are split up into sections. Before installation each of the sections is prestressed according to analysis requirements using circumferential prestressing techniques. Top and bottom closures were designed as multilayered spherical shells which consist of several spherical shell elements separated from each other by thin layers with almost frictionless surface characteristics. The shell elements rest on equally distributed pin-ended steel supports which in turn rest on the upper and lower head-elements of the cylindrical wall. The numerical analysis of a prefabricated axisymmetric pressure vessel which only partially shows a monolithic structural behavior required the extension of a commonly used Finite Element Computer Code. This extension permits analysis of a kinematically stable structure, which due to the stress distribution remains partially monolithic, builds up friction along certain specified element boundaries or allows the separation of adjacent elements. Different possibilities for the computer-orientated simulation of such physical conditions are presented and discussed. Special attention will be given to the iterative solution process. (auth)

8854 (CONF-730942-P6A-S, pp vp Paper H 4/8) ABOUT APPLICABILITY OF HIGH TEMPERATURE STRAIN GAUGES AND DIFFERENTIAL TRANSFORMER DISPLACEMENT TRANSDUCERS FOR THE INSTRUMENTATION OF PRESTRESSED CONCRETE REACTOR VESSELS. Amberg, C.; Czaika, N. (Bundesanstalt fuer Materialpruefung, Berlin). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In prestressed concrete reactor vessels the transducers are exposed to the interference factors such as temperature and nuclear irradiation, as well as chemical influence (corrosion). From the commercially available systems the following electrical transducers were selected, which seemed to be most suitable for these environmental conditions: As strain sensitive elements, fully encapsulated, weldable high temperature strain gauges with integral leads (stainless steel tube construction, welded on steel band) and with nickel-chrome or platinum-tungsten alloy strain sensitive filaments, for static measurements at temperatures up to 320°C or 500°C; for displacement measurements, high temperature differential transformer transducers, with sealed stainless steel housing and integral lead, for temperatures up to 425°C or 580°C. 8 references. (auth)

8855 (CONF-730942-P6A-S, pp vp Paper H 5/1) BOND OF THE LINER AND PENETRATION REINFORCEMENTS TO THE CONCRETE IN PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Huber, G. (Fried. Krupp GmbH, Essen). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of bond of the liner and penetration reinforcements to the concrete in PCPVs is analyzed for the following: the flow of calculation data between the prestressed concrete vessel design and the liner-or penetration-engineering; the required special technical approaches in order to obtain a fixed bond and anchorage; and some suggestions for a new development. 14 references. (auth)

8856 (IFA-NE-15-1974) AUTOMATIC CHANGER FOR 100 IRRADIATED SAMPLES. Pascovici, L.; Hurduc, V.; Popescu, A.; Cercel, L.; Alexandru, R. (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 6p. Dep. NTIS (US Sales Only) $4.00.

8857 (MRR-129) EXPERIMENTAL DETERMINATION OF THE OPERATION AND FAILURE BEHAVIOR OF AN ISOLATION AMPLIFIER. Gossner, S. (Technische Univ. Muenchen, Garching (F.R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Aug 1973. 55p. (In German). Dep. NTIS (US Sales Only) $5.75.

A reliability analysis and a study of failure effects were made on an isolation amplifier. It was attempted to show the rather complex results in a clear manner. (auth)

8858 (MRR-130) EXPERIMENTAL DETERMINATION OF THE OPERATION AND FAILURE BEHAVIOR OF A PULSE MONITORING UNIT. Gossner, S. (Technische Univ. Muenchen, Garching (F.R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Aug 1973. 46p. (In German). Dep. NTIS (US Sales Only) $5.50.

A reliability analysis and a study of failure effects were made on a pulse-monitoring unit. Based on the corresponding results, modifications of the circuit are suggested in order to increase the reliability. (auth)

8859 DEVICE FOR DETECTING THE OVERHEATING OF FUEL ELEMENTS FOR A NUCLEAR REACTOR. Kato, H.; Inour, K.; Imai, M. (to United States Atomic Energy Commission). US Patent 3,801,439. 2 Apr 1974. Filed date 27 Oct 1970. 1p.

A device for detecting the overheating of fuel elements is described in a nuclear reactor of such a type that liquid coolant is allowed to flow through space among a number of fuel elements inserted into the core of the reactor, in which a particular fuel element is provided with a cylindrical or planar septum with a slight interstice therebetween. When the particular fuel element is abnormally overheated, the overheating is detected by detecting the filmy boiling of the coolant flowing in the interstice around the particular element which occurs before the filmy boiling of the coolant flowing in the space around the other fuel elements occurs. (Official Gazette)

8860 LEAK DETECTION SYSTEM FOR A NUCLEAR REACTOR. Apt, J. Jr.; Wachter, W. J.; Rohrer, W. M. Jr. (to USC Inc.). US Patent 3,801,440. 2 Apr 1974. Filed date 3 Nov 1971. 6p.

An elongated slide valve for detecting fuel leaks in a nuclear reactor has a plurality of sampling ports along one side of a valve body and a plurality of intermittently spaced flush ports along an opposing side of the valve body. A slide member alternately communicates with sampling port and flushing port as it sequentially samples the various fuel subassemblies of the reactor through the sampling ports. A single outlet chamber and throughgoing conduit exits each sample from the nuclear reactor to monitoring equipment. The reactor coolant is employed as the flush between samples and as the seal for the slide member. The slide valve is operated by the control rod drive mechanism. (Official Gazette)

8861 PRESSURE VESSEL IN PARTICULAR FOR A NUCLEAR REACTOR. Kraemer, W. (to Aktiebolaget Atomenergi). US Patent 3,801,444. 2 Apr 1974. Priority date 2 Dec 1970, Sweden. 4p.

The invention is concerned with a pressure vessel of prestressed concrete, having an interior steel lining. A plurality of passages are provided in the concrete. If a leak occurs, the leaking pressurized fluid escapes through the porous concrete to the passages. The presence of the pressurized fluid in the passages can be checked by means of pressure gauges. The passages are preferably arranged as two separate sets of passages, the passages of one set forming an angle with those of the other set, making it possible to locate a leak fairly well. (Official Gazette)

8862 PRESSURE-PROOF CONNECTION FOR NUCLEAR REACTOR PRESSURE VESSELS. Kumpf, H. (to Kraftwerk Union Aktiengesellschaft). US Patent 3,801,454. 2 Apr 1974. Priority date 19 Mar 1971, F.R. Germany. 4p.

A pressure-proof connection is provided between a nuclear reactor pressure vessel cover member and a ring shaped member about the cover member. The connection comprises at least two rows of levers disposed one above the other positioned between the cover member and ring. The levers are moved by a cylindrical plate to either lock or unlock the cover and ring member. (Official Gazette)

8863 EFFECTS OF CONDENSER COOLING WATER PARAMETERS ON NUCLEAR POWER PLANTS WITH DISSOCIATING GASES. Mikhalevich, A. A.; Nesterenko, V. B.; Peslyak, V. I.; Sobolevskii, R. G. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 4, 42-48(1973). (In Russian).

The influence of cooling water parameters on the cost index of water refrigeration systems for large atomic power plants with dissociating working substance is analyzed. Minimum of total cost was found as the result of the investigation. (9 references) (auth)

8864 SEALING TESTS ON CONTAINMENT SYSTEMS IN NUCLEAR PLANTS. Com. Naz. Energ. Nucl., Notiz.; 20: No. 3, 60-64(Mar 1974). (In Italian).

The text of the Draft Standard no. 10 approved by UNI's Nuclear Energy Committee in its Rome plenary session of December 5, 1973 is presented. (auth)

8865 EFFICIENCY TESTS ON PARTICLE FILTERING SYSTEMS IN VENTILATION DUCTS. Com. Naz. Energ. Nucl., Notiz.; 20: No. 3, 53-59(Mar 1974). (In Italian).

The text of UNICEN's Draft Standard no. 7 covering air filters installed in nuclear plants approved by UNI's Nuclear Energy Committee in its Rome plenary session of December 5, 1973 is presented. (auth)

8866 STANDARDS FOR COATING MATERIALS IN NUCLEAR PLANTS. Com. Naz. Energ. Nucl., Notiz.; 20: No. 3, 51-52(Mar 1974). (In Italian).

UNI's Nuclear Energy Committee is drafting a set of standards for the classification of points and plastic materials which can be used for coating and lining purposes in nuclear plants. Some of the major aspects of this problem are discussed. (auth)

8867 POWER, CONTROL, AND INSTRUMENTATION CABLE FOR NUCLEAR FUELED POWER PLANTS. La Fetra, F. E.; McGowan, E. J. (Raychem Corp., Menlo Park, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 984-992 (Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The unique problems associated with cables for nuclear fueled power plants are discussed with emphasis on flame retardation, corrosion and insulation life. Comparison between actual life and laboratory test conditions are made. Test methods are described and discussed in relation to specification requirements. (auth)

8868 NEUTRONENMESSTECHNIK UND IHRE ANWENDUNG AN KERNREACTOREN. (Neutron Measuring Techniques and Their Application to Nuclear Reactors). Schneider, W. Schneider, Neutronenmesstechnik. XII. Berlin; Walter de Gruyter and Company (1973). 464p. DM168,-.

Current neutron measurement techniques with special reference to their use in reactors are compiled and systematized. The principles on which neutron measurements are based are discussed in detail. The most important neutron detectors and their operation and characteristics are described. The calibration and evaluation methods used with these instruments are reported. Current measurement practices used in nuclear reactors are outlined. The uses of neutron measurements are discussed. (JSR)

8869 CRITERIA FOR SEISMIC ANALYSIS OF NUCLEAR PLANT STRUCTURES AND SUBSTRUCTURES. Stoykovich, M. (Gibbs and Hill, Inc., New York). Nucl. Eng. Des.; 27: No. 1, 106-120(1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Criteria used for seismic analysis of nuclear power plant structures such as supporting structures founded on ground as well as substructures are described. Nuclear power plant equipment and systems can be treated as substructures. Modeling of structures and substructures is described. Since instructure response spectra play an important role in the design and analysis of nuclear power plant equipment, systems and components, methods for development of instructure response spectra as well as variations of input parameters considered in determining these spectra are described. When the principal contribution to the equipment response is due to flexibility of the supporting substructures, an analytical approach to the problem for obtaining reduced stiffness and associated mass matrices of supporting substructures with finite element representation for use in the dynamic analysis of equipment and supporting structures is presented. When supporting structures and equipment, that have inherently different damping properties, are included as integral parts of the dynamic models, the approximate evaluation of the modal damping based

on the weighted damping according to the modal energy stored in each component is outlined. Use of time history and response spectrum analyses is presented. The effects of relative displacements due to different motion of the support points of substructures in each significant mode of the supporting structures as well as procedures of combining modal responses are detailed. 9 references. (auth)

8870 STATIC, STABILITY, AND DYNAMIC ANALYSIS OF SHELLS OF REVOLUTION BY NUMERICAL INTEGRATION: A COMPARISON. Svalbonas, V. (Grumman Aerospace Corp., Bethpage, NY); Key, J. Nucl. Eng. Des.; 27: No. 1, 30-45(1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The use of numerical integration for the analysis of practical shell-of-revolution structures was documented almost simultaneously in the United States by three independent groups of researchers (Cohen, Kalnins, Mason et al.). These early efforts have been refined, reformulated, and increased in scope and applicability to become major program systems (SRA, Kalnins, STARS). While all three programs utilize basically the same mathematical formulation for integrating the shell differential equations, the matrix solution procedures from this point are basically different. The purpose of this paper is twofold, as follows: (1) to present the differences in solution procedures of the largest system (the Grumman—NASA STARS) from the other two, and point out the inherent advantages of this approach; and (2) compare the numerical integration procedure, as utilized in the STARS, with finite difference and finite element procedures, noting the relative advantages of each in the analysis of shells of revolution for static, buckling, and dynamic loadings. A brief review of the numerical integration procedure for the analysis of shells of revolution is presented, and the matrix solution procedures of the SRA, Kalnins, and STARS programs are contrasted. The limitations imposed by the relative procedures are discussed. The unique formulation utilized by STARS for the solution of stability and vibration problems, and its advantages, are discussed in detail. The STARS program's analytical capabilities, capacity, and user options are compared with those of other major systems utilizing either finite differences or finite elements for the analysis of shells of revolution. Comparisons are made in terms of program size, program accuracy, number of degrees of freedom required for analysis, ease of idealization and user inputs, limitations imposed on analysis capability or output, running time, and so forth. All advantages and differences are demonstrated by use of solutions for realistic shell problems in the areas of statics, stability (including dead and live load distributions), vibrations, and dynamic response of shells subjected to time-dependent loadings. 34 references. (auth)

8871 FRACTURE INITIATION AND PROPAGATION IN A CYLINDRICAL SHELL CONTAINING AN INITIAL SURFACE FLAW. Erdogan, F.; Ratwani, M. (Lehigh Univ., Bethlehem, PA). Nucl. Eng. Des.; 27: No. 1, 14-29(1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The problem of fracture initiation, propagation, and arrest in a pressurized cylindrical vessel which contains an initial surface flaw is analyzed. It is assumed that the flaw has the most unfavorable geometry and orientation, namely, it is a relatively long part-through axial crack. The problem is considered of a crack which is sufficiently "shallow" so that the plastic deformations are confined to the neighborhood of the crack border and part of the net section near the inner wall is still elastic. The plasticity-corrected stress intensity factor obtained from this analysis is the controlling load factor in failure considerations related to fatigue crack propagation, stress corrosion cracking, and static fracture. The problem of relatively deep crack with fully-yielded net ligament is then considered. Plastic deformations are also assumed to spread around the crack ends through the entire wall thickness. A perfectly plastic strip model (with an eight order shell theory) is used to calculate the plastic zone size and the crack opening displacement along the crack border. After the rupture of the net ligament under the crack, the axial crack propagation is accompanied by the depressurization of the vessel caused by leakage. From this point on the fracture problem is coupled with the related fluid mechanics or gas dynamics problem where the primary unknowns are the pressure and the crack length as functions of time. It is assumed that the volume of the vessel is finite and the crack propagation is quasi-static. 20 references. (auth)

8872 WHO BELONGS TO WHOM IN THE GERMAN NUCLEAR INDUSTRY. II. Participation and Obligations. Solfrian, W. (Bonnenberg und Drescher Ingenieurgesellschaft m.b.H., Juelich, Ger.). Atomwirt., Atomtech.; 19: No. 2, 72-76(Feb 1974). (In German).

With the break-through of nuclear power plants for economic energy supply and after severe structural changes on the German market, a grouping of nuclear industry has formed, which will probably remain fixed for a longer period. In a series of four sequences the shares and involvements in the German nuclear industry are shown by diagrams. This second sequence deals with those firms delivering containments, reactor internals made of metallic and of graphite materials as well as steam generators and heat exchangers. (GE)

8873 STANDARDS AND SPECIFICATIONS FOR SELECTING OPTIMUM NUCLEAR REACTOR PRESSURE BOUNDARY METALS: A REVIEW OF US APPROACHES AND NEEDS. Steele, L. E. (Naval Research Lab., Washington, DC). Nucl. Eng. Des.; 27: No. 1, 121-137(1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Standards and specifications which optimize the quality of structural components including pressure boundary materials fill an important place in assuring reactor structural reliability. The way in which research may contribute to improve codes, standards, and specifications for nuclear reactor pressure boundary metals considering radiation and other service environmental effects is analyzed. Examples are cited from studies related to both thermal and fast reactor materials. The organizations and their current emphasis for standards development in the US also are reviewed briefly with specific reference to pressure boundary materials for commercial nuclear power plants. 31 references. (auth)

8874 SEISMIC ANALYSIS OF THIN SHELL STRUCTURES. Kalnins, A. (Lehigh Univ., Bethlehem, PA); Godfrey, D. A. Nucl. Eng. Des.; 27: No. 1, 68-76(1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

A vertically erected, axisymmetric shell, resting on a horizontal foundation is considered. The foundation is subjected to a time-dependent motion in both the vertical and horizontal directions. The motion may be produced by an event such as an earthquake or explosion. An estimate of the response of the shell to such excitation can be obtained from the solution for time-dependent boundary conditions. This solution is adapted here for an analysis with the response spectrum of earthquakes, which has been pioneered by Biot and Housner. The modes of free vibration are calculated by the multisegment, direct numerical integration method using classical shell theory. An actual design case of a containment vessel of a nuclear power plant built in the US is presented. An estimate of the dynamic response of the shell to an earthquake is obtained for all the relevant variables, such as stresses and displacements. As an example, an estimate for the axial stress of the response is given at various stations of the shell. 11 references. (auth)

8875 ASSESSMENT OF ACTUAL LOADING CONDITIONS OF STEAM GENERATORS AND HEAT EXCHANGERS ACCORDING TO PROBABILISTIC CRITERIA. Beckmann, G.; Fritz, K. (Waagner-Biro AG, Vienna). Nucl. Eng. Des.; 27: No. 1, 57-67 (1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Classical design codes are based on nominal conditions, e.g., pressure, temperature, material strength and tube diameter for tubes under pressure; local loads, hot spots, deviations in strength and geometry, etc. are compensated by the use of safety factors. More recent methods—in particular those for the assessment of steam generators and heat exchangers for nuclear applications—call for designs to meet actual loading conditions. Thus, detailed investigations are required to determine realistic operational characteristics of the components to be assessed. However, a worst case treatment on the basis of the above criteria would yield an over-conservative design which in special cases might even be worse than the classical one, e.g., in the case of heated tubes due to increased thermal stresses. As a consequence, with all the data or the spectra of data available, the assessment has to be executed according to probabilistic criteria resulting in a design with an acceptably low and, above all, known failure rate adjusted to fit into the overall plant concept. In components to which the above criteria have been applied before—mainly pressure vessels—the design variables pressure and temperature are generally considered uncorrelated and the temperature is in most cases assumed to be constant. For heat exchangers and steam generators these simplifications are not acceptable on principle. On the contrary, even deviations in geometry (like tube tolerances) result in flow rate deviations with corresponding deviations in temperature and pressure. Thus a new procedure for assessment according to actual loading conditions, e.g.,

by the application of probabilistic criteria, is proposed. This procedure can be used for heat exchangers and steam generators. With this new method, components of nuclear power plants like steam generators and heat exchangers may be designed to meet the low failure probability required for satisfying the overall reliability concept of the plant. 12 references. (auth)

8876 GENERALIZED PROCEDURES FOR THE USE OF PLANE STRAIN AND ELASTIC-PLASTIC FRACTURE MECHANICS OPTIONS IN THE MODERNIZATION OF NUCLEAR STANDARDS. Loss, F. J.; Hawthorne, J. R.; Pellini, W. S. (Naval Research Lab., Washington, DC). Nucl. Eng. Des.; 27: No. 1, 77-93(1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Recent developments in the means for defining the full range of plane strain, elastic-plastic, and plastic fracture mechanics options available to the designer are described. Comparisons are made between these options and the fracture toughness requirements of the ASME Nuclear Code (Section III). Existing dynamic plane strain, K_{Id}, data for structural metals are analyzed in concert with dynamic tear (DT) test trends. The limited temperature region of K_{Id} applicability for these materials is shown to presage the elastic-plastic regime through which sharply increasing stress is required for fracture propagation whereby a leak-before-fail condition is ultimately attained. This phenomenon highlights the need to extend the analytical capabilities for fracture assurance into the non-brittle regime. The DT test is an effective engineering tool which, like the crack opening displacement (COD) concept, can be used to define the elastic-plastic and plastic-constraint transitions. The DT test procedure is fully rationalizable in terms of section size parameters and can be used independently or together with the K_{Id}-temperature trend to predict the onset of the elastic-plastic and plastic regimes as a function of temperature and section thickness. 15 references. (auth)

8877 TECHNIQUE FOR THE MEASUREMENT OF THE STEAM CONTENTS OF A COOLANT DIRECTED THROUGH THE FUEL ELEMENT CHANNELS IN THE CORE OF A NUCLEAR REACTOR. Ward, A. G. (to Atomic Energy of Canada Ltd.). German (FRG) Patent 1,589,444. 22 Mar 1973. 3p. (In German).

A γ-radiation emitted by ^{16}N from the cooling medium outside the reactor core has been measured and the steam content has been determined from this γ-radiation measurement, temperature and flow rate measurements on the cooling medium, as well as from neutron flux measurements. The determination of the steam content followed from the calculation of the measured data using a computer. (GE)

8878 CALCULATION OF HYDRODYNAMIC PARAMETERS OF ROD BUNDLES. Subbotin, V. I.; Ishakov, P. A. (State Committee for Atomic Energy, Obninsk, USSR). pp 44-57 of Simulation Techniques in the Investigation of Thermokinetic Effects in the Core of Fast Reactors. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Babylon, Czechoslovakia (23 Feb 1970).

The results are discussed of computing hydrodynamic characteristics and temperature conditions in the bundles of smooth rods by-passed by liquid metal in a wide range of relative rod pitches. The results obtained by computation are compared with literature data and generalized. The methods are briefly reviewed of the approximative computations of the flow of liquids through channels of complex shape. (Nucl. Sci. Abstr. Czech.)

8879 CALCULATION OF TEMPERATURE FIELDS IN CHANNELS OF NON-CIRCULAR CROSS-SECTION. Ibragimov, M. Kh.; Subbotin, V. I.; Bobkov, V. P. (State Committee for Atomic Energy, Obninsk, USSR). pp 104-111 of Simulation Techniques in the Investigation of Thermokinetic Effects in the Core of Fast Reactors. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Babylon, Czechoslovakia (23 Feb 1970).

A method is described of calculating the hydraulic resistance, circumferential distribution of tangential stresses, and coefficient of turbulent heat diffusion for a steady-state flow of liquids in straight smooth channels of various cross-sections. The method is based on the experimental data obtained in studying the statistical characteristics of velocity and temperature pulsations, and serves the calculation of the temperatures fields in the channels. (Nucl. Sci. Abstr. Czech.)

8880 METHOD OF CALCULATING TURBULENT HEAT TRANSFER COEFFICIENTS IN CHANNELS OF COMPLEX SHAPE. Bobkov, V. P.; Ibragimov, M. Kh.; Subbotin, V. I. (State Committee for Atomic Energy, Obninsk, USSR). pp 8-16 of Simulation Techniques in the Investigation of Thermokinetic Effects in the Core of Fast Reactors. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Babylon, Czechoslovakia (23 Feb 1970).

A method is described of calculating the coefficients of turbulent heat transfer during the flow of liquid through straight smooth channels of various cross-section. The method is based on equations of the homogeneous turbulent diffusion theory and on experimental statistical characteristics of velocity and temperature pulsations. The method permits considering the anisotropy of the turbulent heat transfer coefficients; this is of a particular importance in the analysis of heat transfer in non-circular channels. The application of the obtained turbulent heat transfer coefficients yields a sufficient agreement between the calculated and the experimental temperature fields in channels of complex shape. (Nucl. Sci. Abstr. Czech.)

8881 VELOCITY FIELD OF TURBULENT FLUID FLOW IN CASE OF LONGITUDINALLY BY-PASSED ROD BUNDLES. Subbotin, V. I.; Ushakov, P. A.; Levchenko, Yu. D.; Aleksandrov, A. M. (State Committee for Atomic Energy, Obninsk, USSR). pp 158-183 of Simulation Techniques in the Investigation of Thermokinetic Effects in the Core of Fast Reactors. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Babylon, Czechoslovakia (23 Feb 1970).

The results are discussed of measuring the velocity fields in non-circular channels simulating the cells of an infinite bundle of rods. The cross-sectional shape of the channel was determined by two neighboring cells of a bundle of rods in a triangular lattice delimited by spacers. Presented are the velocity fields and the distribution of tangential stresses along the circumference of rods placed in a lattice with a relative spacing of 1.0 to 1.2. The empirical relationship was obtained of the hydraulic resistance of the bundle of rods and the relative spacing. Over the relative spacing range studied, the velocity profiles perpendicular to the wall were found to be in sufficient agreement with the data for circular channels. The existence of secondary streams was ascertained in the channel simulating a bundle of 1.05 space rods. The measuring method is described, and results are given for Re numbers ranging between 15×10^3 and 100×10^3. (Nucl. Sci. Abstr. Czech.)

8882 CONTROL OF DIESEL EMERGENCY POWER SUPPLIES IN NUCLEAR POWER PLANTS. Amberger, H. (Siemens A. G., Erlangen, Ger.). Siemens-Z.; 47: No. 12, 828-831(Dec 1973). (In German).

The emergency power bus bar with four diesel emergency power supplies of which each achieves 50% of the required capacity, the electronic and mechanical part of the control systems, and the functions are briefly described. (GE)

8883 IMPROVEMENT OF CONTROL BEHAVIOR OF STEAM GENERATORS BY STRUCTURE-OPTIMIZED CONTROL. Dettinger, R.; Welfonder, E.; Herbrik, R. (Univ., Stuttgart). Brennst.-Waerme-Kraft; 26: No. 2, 43-54(Feb 1974). (In German).

The operation of structure-optimized control, as well as with its application to steam generators are presented. In the case of structure-optimized control, the concept of control is not stated but included into the optimizing calculation. In this way, a more favorable control behavior and faster load changes can be achieved than with the parameter-optimized control usually applied. This is proved with the help of simulation studies, as well as by comparative measurements on a special once-through forced-flow steam generator. (GE)

8884 CONTROL OF IMPURITIES IN SODIUM COOLANT LOOPS. Ullmann, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 17: No. 1, 5-10(Jan 1974). (In German).

Application of sodium cooling technology in nuclear industry requires new, sensitive trace element analysis and measuring techniques. Special regard has to be given further improvement of oxygen, hydrogen and carbon monitoring in the sodium. Development is directed towards continuous selective measuring techniques detecting the chemically effective content of these impurities. Some problems of analysis and measurement in sodium technology can be solved by conventional chemical, physical or radiation measuring techniques, among them inert gas control, determination of many metallic or nonmetallic trace amounts in

the sodium, and fission product control in the sodium and inert gas. Features of their application in sodium technology are sampling technique and sample treatment as well as the high ^{24}Na activity in radiochemical analysis. Requirements, status, and main directions of development are presented. 61 references. (auth)

8885 WORK-LOCATING FIXTURE FOR SAMPLE HOLDER ADJUSTABLE IN IRRADIATION CHANNELS OF NUCLEAR REACTORS. Scholz, M. (to Siemens AG). German (FRG) Patent 2,053,276. 22 Feb 1973. 3p. (In German).

The discovery concerns sample holders which are threaded on to a centrally led supporting rope of a sample column. The work-locating fixture is there to hold such a sample column in the irradiation channel during the irradiation, firmly and free of oscillation. The device should be able to simply be unlocked from the outside when changing the sample column. The technical details of the work-locating fixture are given. (GE)

8886 OPTIMIZATION PROBLEMS ON REACTOR SHIELDS. I. Optimization Techniques and Models. Kanai, Y.; Ito, Y. (Ship Research Inst., Tokyo). Senpaku Gijutsu Kenkyujo Hokoku; 10: No. 5, 259-280(Sep 1973). (In Japanese).

A review is presented of the recent works on the reactor shield optimization in various countries such as Japan, the United States, the Soviet Union, the United Kingdom and the Federal Republic of Germany. Most of the works including our original studies were presented at the two international meetings on the problems of reactor shielding which were held in Paris, France in 1970 and 1972. All these works have recourse to either of linear programming, gradient method, dynamic programming and so on as optimization techniques. Thus, explanation is given for these techniques. (auth)

8887 PUMPS FOR NUCLEAR POWER STATIONS. Frei, A.; Kuendig, J. Polytech. Tijdschr. Procestech.; 29: No. 5, 157-164 (6 Mar 1974). (In Dutch).

A general discussion is presented of the peculiar problems (arising principally from intense radiation levels) associated with pumps for nuclear power stations. How these problems have been overcome is illustrated with detailed descriptions of the design and operation of some particular feed-, circulator- and condenser-pumps. (FEG)

8888 THERMODYNAMIC CYCLES OF AN ATOMIC ELECTRIC POWER PLANT WITH MHD GENERATORS. Dekhtyarev, V.L.; Khalaidzhi, V.N.; Smolkin, Y.V.; Kopp, I.Z. (Odessa Technological Institute of the Refrigeration Industry). High Temp. 11: No. 2, 336-339 (Nov 1973).

The most rational thermodynamic cycles are selected in order to attain high temperatures of an inert coolant in high-temperature gas-cold reactors. MHD generators operating on nonequilibrium plasma are investigated primarily. (AIP)

Reactor Fuels

Refer also to abstracts 6194, 6567, 7233–7236, 7238, 7257–7260, 7281, and 8917.

8889 (CONF-730942-P6A-S, pp vp Paper D 3/4) EXPERIMENTAL STUDY OF FLOW-INDUCED VIBRATION OF A CANTILEVER IN AXIAL AIR-WATER FLOW. Harris, R. W.; Holland, P. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Flow-induced vibrations of a cylindrical cantilever in an axially flowing air/water mixture were measured for a range of volumetric flow rate ratios up to approximately 0.7, for three different constant water mass fluxes of 750, 1,350 and 1,950 $kg/m^2/s$. The results were obtained for two flow conditions: flow on to the free end of the cantilever ("free-end flow") and directly on to the fixed end (and thence over the free end) ("fixed-end flow"). The effect of four different end shapes on the flow-induced vibration for free-end flow was measured for one water mass flux of 1,270 $kg/m^2/s$, and for a range of volumetric flow rate ratios up to approximately 0.7. The end shapes investigated were blunt, pyramidal, hemispherical and cusp shaped. 3 references. (auth)

8890 (CONF-730942-P6A-S, pp vp Paper D 3/5) EXPERIMENTAL STUDY OF VIBRATION OF A CLUSTER OF FLEXIBLE HOLLOW CYLINDERS IN AXIAL AIR-WATER FLOW. Winsbury, G. J.; Ledwidge, T. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Experiments have been carried out to measure the vibration response of a cluster of 7 air-filled, thin-walled tubes representing part of a nuclear fuel element structure. The vibration of the tubes was detected by a strain gauge device fitted inside each tube. The fluid mass flux varied over the range 186 to 371 $kg.m.^{-2}s.^{-1}$ and the volumetric flow ratio (β) varied between 0.50 and 0.94. Vibration of the tubes reaches a maximum at a value of β which depends only slightly on the mass flux and, for the tests reported, these maxima occur for values of β between 0.86 (at 186 $kg.m.^{-2}s.^{-1}$) and 0.80 (at 371 $kg.m.^{-2}s.^{-1}$). 6 references. (auth)

8891 (NT-31-1972) THERMOHYDRAULICS OF NUCLEAR REACTOR FUEL ASSEMBLIES AND RELATED PROBLEMS. Summary Report, 1968–1971. Michel, A.; de Heering, D.; Mestree, J. (Brussels Univ. (Belgium)). 1972. vp. INIS.

A hydraulic and thermal test facility was developed four years ago to support the design and analysis of fuel elements for water, sodium and gas cooled reactors. The basic principle is to deal with well defined engineering problems such as the evaluation of pressure drop, the analysis of flow and temperature distributions in the fuel rod bundles, etc. Suitable experimental techniques were not always available, so new techniques and tools were developed e.g. small diameter instrumented rods or flow separation techniques. (BE)

8892 CERAMIC NUCLEAR FUEL OR BREEDER MATERIAL TABLETS AND METHOD OF PRODUCING THE SAME. Scharf, H. (to Siemens Aktiengesellschaft). US Patent 3,801,451. 2 Apr 1974. Priority date 20 Dec 1968, F.R. Germany. 4p.

Ceramic fissionable fuel or breeder material tablet axially alignable with corresponding tablets for forming nuclear reactor fuel rods includes a substantially cylindrical member having a depression at opposite end faces thereof. The end faces comprise a marginal zone of slightly sloping conical shape having an angle of inclination within a range of 0.5° to 30°. The inclined marginal zone define, with the remaining surface of the respective end face, an annular contact edge for contacting an end face of another tablet axially alignable therewith, the annular contact edge being spaced from the peripheral edge of the end face a given distance so that compression forces acting on the annular contact edge when the tablet is in use in a nuclear reactor fuel rod, are absorbable by a spatial region of the table having adequate strength for absorbing the compression forces. (Official Gazette)

8893 NUCLEAR REACTOR FUEL ELEMENTS. Milburn, G. (to United Kingdom Atomic Energy Authority). US Patent 3,801,452. 2 Apr 1974. Priority date 3 Sep 1969, United Kingdom of Great Britain and Northern Ireland. 2p.

A fuel pin spacer grid has apertures through which the fuel pins extend. Each fuel pin bears against two pairs of longitudinally spaced stop members being biassed against the stop members by spring means acting on the fuel pin intermediate the pairs of stop members. The stop members are semi-resilient so as to allow small lateral deflections of the fuel pins but so as to become rigid to prevent greater lateral deflections of the fuel pins. (Official Gazette)

8894 NUCLEAR REACTOR FUEL ELEMENT. Bresnick, S. D. (to United Nuclear Corp.). US Patent 3,804,710. 16 Apr 1974. Filed date 9 Dec 1970. 4p.

A tubular fuel element is described which has end plugs welded to each end with reproducible high quality welds. The tube contains fissionable fuel in any form but advantageously in the form of pellets partially filling the tube leaving a void space at one end for the reception of the fission gases. A compression spring of nickel, or an alloy of nickel, is located within this space to hold the fuel pellets in position. The end plugs, made of a zirconium alloy, are each provided with a head portion for engaging the fuel at the bottom end and the spring at the top. The surface of the head is spaced a suitable distance from the welded joint at the end of the tube and the head is connected to the inner portion of the end plug by a narrow neck portion. This construction prevents excessive stresses in the weld and adjacent tubing during service, and at the top end prevents the heat of welding from inducing the formation of a brittle nickel–zirconium eutectic in the adjacent materials. (Official Gazette)

8895 SOME APPLICATIONS OF BEAM, COLUMN AND PLATE THEORY TO PROBLEMS OF REACTOR FUEL ELEMENT DEFORMATIONS. Anderson, R. G. (United Kingdom Atomic Energy Authority, Lancashire, Eng.). Nucl. Eng. Des.; 27: No. 1, 46-56(1974).

From conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Most early discharges of nuclear reactor fuel elements have been associated with exposure of the fuel to the coolant. Such

failures have dominated the design and developments of gas and water-cooled thermal reactor fuel. It is less well known that a number of fuel discharges and reactor output limitations have taken place in thermal reactors because of fuel element deformations which have occurred without loss of clad integrity. Recent developments in the physical understanding of fuel element deformations during life are reviewed. The important features of these deformations are established using approximations leading to simple theoretical analyses of fuel elements deforming in the presence of creep. This theoretical treatment is applied illustratively to the following problem areas: (1) the change of thermal bow as the bending moments induced by lateral restraints relax due to creep; (2) the restraint of fast reactor subassembly bowing; (3) the estimation of lateral deflections in lengthening fuel pins which are restrained axially; and (4) the causes of waving of the heat transfer surfaces of certain uranium–magnox fuel elements. It is concluded from these examples that many of the characteristics of fuel element deformations during life can be obtained from quite simple ideas and mathematical analyses. The methods thus provide a useful tool for design and research. 27 references. (auth)

8896 RADIAL SPLINE GUIDE BEARING ASSEMBLY. Heald, W. R. (to United States Atomic Energy Commission). US Patent 3,805,552. 23 Apr 1974. Filed date 17 Oct 1972. 6p.

An elongated shaft is axially assembled within a guide bearing which provides lateral support while permitting longitudinal movement. The bearing includes inwardly projecting ribs which intermesh with outwardly projecting splines from the shaft. Adjacent lateral guide surfaces of the ribs and splines are in slidable contact and each guide surface coincides with a radius from the longitudinal axis of the assembly. Space for unequal thermal expansion of the member and bearing is provided beyond the distal surfaces of the splines and ribs. (Official Gazette)

8897 FUEL ELEMENT FOR NUCLEAR REACTORS. Boettcher, A. German (FRG) Patent 2,142,744. 15 Mar 1973. 5p. (In German).

The described fuel contains in the inner part of the fuel rod or breeder rod, a material to improve the heat transfer to the metallic cladding, which is a liquid at the operational temperatures of the metallic cladding. The fuel or breeder material may be in the form of spherical particles or hollow pellets. In the arrangement, the vaporizing heat transfer medium in the axial zone of the fuel or breeder region condenses on the inner walls of the fission gas plenum and by gravitational force or capillary effect is led back into the fuel or breeder zone. (GE)

8898 FUEL ROD BUNDLE FOR NUCLEAR REACTORS. Lass, J. L.; Venier, D. A. (to General Electric Co.). German (FRG) Patent 1,539,867. 1 Feb 1973. 9p. (In German).

In the fuel element bundle described, numerous fuel rods are held in a given geometrical arrangement by grid plates fixed to their ends. At least one pair of these rods are bound to one another by a locking device to prevent the rods from turning. There are means of fastening the grid plates onto this rod pair. The technical details of the locking and fastening are described. (GE)

8899 HYDROGEN-PROOF FUEL CAN SEAL OF NUCLEAR REACTOR FUEL RODS. Gregorius, K.; Peehs, M. (to Siemens AG). German (FRG) Patent 2,155,243. 10 May 1973. 7p. (In German).

A seal is described for an inner enameled cladding tube whose filling material consists of a mixture of nuclear fuel and a metal hydride as a moderator. In the inner part of the fuel rod, in front of the end cap welded to the cladding tube, there is a bowl-shaped seal whose opening is turned towards the nuclear fuel. The breed body enameled on all sides is connected to the enameled layer of the cladding tube by a glass solder under pressure. The hollow of the seal is filled with a hydrogenized metal or a metal hydride body. The process for the preparation of the functioning of the seal is described. (GE)

Reactor Control Systems

Refer also to abstracts 8471 and 8938.

8900 (GA-A-12865) HTGR GAS TURBINE POWER PLANT CONTROL AND SAFETY STUDIES. Quarterly Progress Report for the Period October 1, 1973–December 31, 1973. (General Atomic Co., San Diego, Calif. (USA)). 6 Feb 1974. Contract AT(04-3)-167. 87p. Dep. NTIS $5.45.

The steady-state performance of the HTGR gas turbine has been analyzed with a code which includes models for the precooler and dry tower. Analysis of the plant in various control modes is described, including the effects of delivering bypass flow to different points in the loop. The transient response of the power plant to various perturbations with and without control action is examined, and a basic control scheme for the plant is reported. Safety analysis of the HTGR gas turbine has been performed and includes analysis of flows following duct rupture, mechanical failures, and plant configurations to minimize the effects of such failures. The outline of a Preliminary Safety Information Document for the plant is also discussed. (auth)

8901 (N-73-27581) DYNAMIC ANALYSIS OF GAS-CORE REACTOR SYSTEM. Final Report. Turner, K. H. Jr. (Science, Technology and Research, Inc., Atlanta, Ga. (USA)). Mar 1973. Contract NAS3-16735. 79p. (NASA-CR-121253). NTIS $6.00.

A heat transfer analysis was incorporated into a previously developed model CODYN to obtain a model of open-cycle gaseous core reactor dynamics which can predict the heat flux at the cavity wall. The resulting model was used to study the sensitivity of the model to the value of the reactivity coefficients and to determine the system response for twenty specified perturbations. In addition, the model was used to study the effectiveness of several control systems in controlling the reactor. It was concluded that control drums located in the moderator region capable of inserting reactivity quickly provided the best control. (auth)

8902 (WCAP-7617(Suppl. 5)) SEISMIC TESTING OF ELECTRICAL AND CONTROL EQUIPMENT (INSTRUMENT BUS DISTRIBUTION PANEL). Vogeding, E. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Mar 1974. 13p.

The instrument bus distribution panel, which distributes vital a-c power to the reactor protection and safeguards actuation equipment, was tested under simulated seismic conditions (covering the "low seismic" class of plants) to ensure that this equipment is capable of performing its function both during and after the earthquake. The equipment tested is representative of the instrument bus distribution panel that is installed in the "low seismic" class of plants. The test results show that the electrical functions of the equipment were maintained both during and after the simulated seismic condition. (auth)

8903 MINIMAL TIME CONTROL OF SPATIAL XENON OSCILLATIONS IN NUCLEAR POWER REACTORS. El-Bassioni, A. A.; Poncelet, C. G. (Carnegie-Mellon Univ., Pittsburgh). Nucl. Sci. Eng.; 54: No. 2, 166-176(Jun 1974).

The theoretical minimal time modal control strategy to suppress xenon oscillations in nuclear reactors was found to be of the Bang-Bang type. Such control policy implies instantaneous variation of the control poison between two extreme values. The switching action depends on exact knowledge of the location of the reactor state in the phase plane. The state is related to the measured axial off-set, and the concept of axial offset phase plane is introduced. The main features of this phase plane can be constructed using a semi-operational method. Using the Carnegie–Mellon University xenon spatial control simulator, optimal and off-optimal control policies were tested and the capability to suppress the oscillation was demonstrated. Some of the attractive features of this suggested method are the simplicity of control policies, use of reactor output data, and the ability to initiate the control action once the oscillation is detected and to predict beforehand the outcome of the control decision, thus increasing the operator capacity to modify his decision. (auth)

8904 VENTILATION OF NUCLEAR REACTION FUEL RODS. Heenan, W. A. US Patent 3,801,447. 2 Apr 1974. Filed date 16 Nov 1971. 4p.

This invention relates to a venting device for nuclear reactor control and fuel rods having fissionable material contained in a cladding. The venting device is characterized by a porous disk forming part of the wall of the rod. The disk allows the fission gases to pass through and prevents the liquid sodium coolant from entering the rod. (Official Gazette)

8905 CONTROL ROOM STANDARDIZATION: A SAFETY GOAL. Hanauer, S. H. (Atomic Energy Commission, Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 957-958(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Nuclear power plant control room design and layout should be substantially standardized to enhance safety and also for improved human engineering, operability, and economy. (auth)

8906 CONSTRUCTION EXPERIENCE WITHIN THE CONTROL AND SPREADING ROOM COMPLEX. Sandel, A. L.

(Bechtel Corp., San Francisco). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 959-960(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Construction problems within the control room and its associated cable spreading rooms that are due to space limitations, poor access for electricians, and state-of-the-art changes initiated during the testing phases of a nuclear generating plant are examined. The effects of these problems on manpower are discussed. Solutions for the specific problems are suggested in conjunction with the overall recommendation for more active participation by the construction engineer with the designers, manufacturers, and clients in regard to initial layout of these critical areas, including wire space allowances in the control packages. (auth)

8907 SEPARATION: A MATTER OF MAGNITUDE. Cotta, R. E. (Sargent and Lundy, Chicago). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 961-963(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

Basic separation philosophy has been stated in the Code of Federal Regulations 10CFR50 and in IEEE 279 and 308. More detailed guidelines in the form of a standard should be developed to supplement these standards and to establish some quantitative values. Major road-blocks in the development of such a standard are definitions, inclusion of non-safety class circuits and equipment, and the utilization of restricted areas. (auth)

8908 CONSIDERATIONS IN STANDARDIZING CONTROL ROOM ARRANGEMENTS. Brandt, D. W.; Clay, H. R. (General Electric Co., San Jose, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 964-970(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The key to expeditious design, construction and licensing of today's Nuclear Power Plant is standardization—standardization of site arrangement, building arrangement, control room layout, system design and construction. The problems of standardizing the control room are discussed. A review of the factors that affect the room arrangement, such as building dimensional constraints, operational requirements and economics, indicates that a standard arrangement can be achieved. Improvements can also be incorporated, after sufficient evaluation, through the release of a new updated standard. And finally, some solutions to the implementation question may be to establish licensing priorities, to limit supplier design options and to establish standards through engineering societies. The mounting energy crisis is forcing decisions in many areas and the obvious advantages of standardization will become even more evident in the immediate future. (auth)

8909 FLOATING NUCLEAR PLANT PRE-ASSEMBLED CONTROL MODULE. Leivo, J. M.; Cooney, R. J. (Offshore Power Systems, Jacksonville, FL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 971-974(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The design and construction of nuclear power plants has always involved much effort in the electrical area relative to that required in many other industries. This is a result of the relatively large quantities of components that are centrally controlled and plant variables that are centrally monitored, together with separation criteria imposed on safety-related circuits. The Floating Nuclear Plant has basically these same considerations in electrical design and construction as a land-based plant, but in addition has a much shorter plant manufacturing lead time as a design objective. Thus, the electrical installation—which is typically on the critical path at peak effort near the end of the plant construction schedule—could be a bottleneck if conventional electrical installation methods were used. A design for reducing electrical installation lead time by reducing termination time and maximizing simultaneous installation effort through use of a prefabricated control module is discussed. (auth)

8910 MULTIPLEXED INPUT/OUTPUT SYSTEM FOR COMPUTERS IN HTGR NUCLEAR POWER PLANTS. Nau, D. C.; Miller, G. S. (Gulf General Atomic Co., San Diego, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 993-997(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The multiplexed I/O system and the specifically designed interface to computers for use in HTGR nuclear power plants are described. The overall system design philosophy and functional requirements are discussed, including cost and reliability incentives, message format, data security and data rate, and system functional elements. Engineering design details of the system are described, with particular emphasis on the I/O system architecture and the computer to I/O system interface. (auth)

8911 EVALUATION OF THE NUCLEAR STEAM SUPPLY SYSTEM INSTRUMENTATION AND CONTROL EQUIPMENT DURING INITIAL MAINE YANKEE OPERATION. Dowd, G. T. (Yankee Atomic Electric Co., Westboro, MA); Wood, E. C.; Veirs, J. W. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 940-949(Feb 1974).

From 20th nuclear science symposium and fifth nuclear power systems symposium; San Francisco, CA (14 Nov 1973).

The initial installation, startup, and operation of the Maine Yankee Nuclear Steam Supply System (NSSS) instrumentation and control equipment are described. Major instrumentation and control system and components are evaluated with regard to problems which occurred during initial testing and operations. Resulting modifications are described. (auth)

8912 POSSIBILITY OF THE OPTIMUM CONTROL OF THERMAL PROCESSES IN NUCLEAR POWER REACTORS. Zaluzhnyi, G. I. (Inst. of Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 4, 5-12(1973). (In Russian).

The analytical study was undertaken to determine the conditions for optimality in the governing of the thermal process in the reactor channel. A two-measured conjugated heat transfer problem of optimum control of the unsteady-state thermal process in watercooled reactors is considered. The influence of governing parameters have been analyzed in two cases: when the reactivity changes linearly, and when the reactivity changes arbitrarily. 9 references. (auth)

8913 INHERENT AUTOMATIC REACTOR CONTROL. Griffith, J. D.; Ketola, H. N.; Finnemore, F. M. (to Secretary of the Army). US Patent 3,802,992. 9 Apr 1974. Filed date 19 Oct 1965. 8p.

This invention relates to an automatic control means for a nuclear reactor, specifically to a means for regulating the energy release rate within the core of a liquid moderated reactor. The regulation is effective under both normal and emergency operating conditions. Of greatest significance to this invention is the density altering means whereby the container is occupied by a material under conditions of supercritical temperature and pressure and the density is altered by altering the temperature or pressure, or both. (Official Gazette)

8914 THERMIONIC REACTOR ELECTRICAL CONTROL SYSTEM. Wilkins, D. R.; Hill, P. R. (to United States Atomic Energy Commission). US Patent 3,801,445. 2 Apr 1974. Filed date 28 Sep 1972. 6p.

A thermionic reactor electrical hookup and control system is described which provides for regulation of plant electrical output, individual control of fuel element emitter temperatures, and isolation of fuel element failure events. The control system is applicable to fast and thermal spectrum thermionic reactors for ground, sea and space applications. (Official Gazette)

8915 PROCESS OF THE BINDING OF THE EXCESS REACTIVITY OF NUCLEAR REACTORS. Mattern, J. (to Licentia Patent-Verwaltungs GmbH). German(FRG) Patent 1,921,528. 23 Aug 1973. 3p. (In German).

The process works by means of movable control rods and on a certain position in the fuel element bundle individual adjustable rods of combustible absorber material. The share of excess reactivity bound by the combustible absorber rods is increased by reducing the share bound by the movable control rods in that certain adjusting positions are chosen for the combustible absorber rods. (GE)

8916 STABILITY ANALYSIS PROCEDURE FOR RELAY SYSTEMS IMPLEMENTED ON MINICOMPUTER WITH APPLICATION TO NUCLEAR REACTOR CONTROL. Tsouri, N.; Rootenberg, J.; Lidofsky, L. J. (Columbia Univ., New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 4, 25-31 (Aug 1973).

A procedure is presented for stability analysis by the Tsypkin Locus method of an unforced control system with relay-type actuator. The procedure was written with special attention given to the minimization of the computation time; thus it may be efficiently executed on a minicomputer. The procedure and a flow chart are presented and the case of a nuclear reactor control is given as an example. 5 references. (auth)

8917 PROGRESS IN GAS-COOLED NUCLEAR-REACTOR CONTROL, PROTECTION, AND DATA PRESENTATION. Law, H. (General Electric Co. Reactor Equipment Lab., Whetstone, Eng.). G. E. C. J. Sci. Technol.; 40: No. 4, 149-158(1973).

Control, protection and data-presentation systems and equipment on British gas-cooled reactors have been developed and improved over the years as a result of progressively more detailed theoretical studies, practical experience, and the availability of new generations of equipment. This development is traced from Calder Hall to Heysham and functionally similar systems and equipment for each station are compared under the following main headings: reactor and station output control, control-rod systems, reactor safety and protection, and centralized control and data processing. (auth)

Nuclear Power Plant Economics

8918 (NP-19964, pp vp, Paper 1) BALANCING SOCIAL AND PRODUCTIVE NEEDS IN EXPANSION FOR ELECTRIC GENERATING CAPACITY. Dragoumis, P. (Potomac Electric Power Co., Washington, DC). 1973.

In seminar on the engineering aspects of siting and operating power plants.

Energy demand projections, electric power production economics, the effects of environmental considerations on power plant siting and planning, fuel resource problems, and the relative merits of fossil-fuel and nuclear power plants are discussed. (LCL)

8919 (NP-19994) OVERALL EFFICIENCIES OF NUCLEAR POWER. Hoffman, E. J. (Wyoming Univ., Laramie (USA). Coll. of Engineering). Dec 1971. 81p.

The overall efficiency of the nuclear power generation cycle is examined from the standpoint of determining the equivalent of electrical energy that would be required to be recycled for mining, concentration, and enrichment in the fuel processing cycle. It is suggested that the actual heat energy given off by the nuclear reaction in a plant may be only a fourth or less of the theoretical or ideal value, and it is further speculated that the theoretical values could stand further examination. Net overall efficiencies indicate that as much as the order of half of the gross electrical output of a nuclear plant would have to be recycled to supply input for fuel processing. The exact figure will depend upon fuel burnups and plant or thermal efficiency, as well as the energy input requirement per ton of fuel—which also was found to vary. As a further result, levels of net energy realization from nuclear power may be a full order of magnitude (factor of ten) below predictions. It is estimated that the reserves of carbonaceous fuels in the United States represent an energy content of one thousand times that which would be effective for naturally-occurring sources of fissile uranium, and possibly ten times that recoverable from breeding of U-238. (auth)

8920 ENERGY CRISIS AND NUCLEAR ENERGY. Franco, G. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 20: No. 3, 25-31 (Mar 1974). (In Italian).

The present energy picture is reviewed with special regard to nuclear energy. Economic information is presented on the cost of electric power generated by a nuclear plant. (auth)

8921 NUCLEAR POWER, SAFETY, AND ENVIRONMENT. Eklund, S. (International Atomic Energy Agency, Vienna). Int. At. Energy Agency Bull.; 16: No. 1/2, 49-59(1974).

An overall picture is presented of the nuclear energy situation in the world and the problems associated with this new energy source and how they are dealt with. The way an individual country decides to face its energy problems will depend, of course, on its own natural resources, the stage of its industrial development and other factors that cannot be generalized for the whole world. (auth)

8922 NUCLEAR FALLING OUT. Leach, R. Manage. Today; 81-85(Apr 1974).

Reasons for the setbacks in the British nuclear power program are examined. It is concluded that the failure of Britain to keep the world lead in nuclear power is due to underestimation of engineering difficulties, inadequate management, wasteful fragmentation of effort, and insufficient standardization of design. The importance of an early decision on the next generation of reactors, based on the lessons learned from these past experiences, is stressed and suggestions are made for the measures to be taken for more effective management and organization. (UK)

8923 IMPACT OF OIL PRICE INCREASES ON THE MARKET FOR NUCLEAR POWER IN DEVELOPING COUNTRIES. Lane, J. A. Int. At. Energy Agency Bull.; 16: No. 1/2, 66-71(1974).

In August 1973, the Agency concluded a market survey of nuclear power in fourteen selected developing countries throughout the world. The results of this survey have been reported in fourteen country reports and a general report and also in a summary report presented at the Seventeenth Regular Session of the Agency's General Conference. These results indicate that in the fourteen countries surveyed, about 60,000 MW(e) of nuclear plant capacity might be put into operation during the period 1980 to 1989. Most of this nuclear capacity would be in the form of units of 600 MW(e) or larger since under the assumed economic conditions, nuclear units in the 200–400 MW(e) size range were generally found to be uneconomical compared to oil-fired plants. 3 references. (auth)

8924 POSSIBLE DEVELOPMENT OF NUCLEAR ENERGY IN THE EUROPEAN COMMUNITY AND INFLUENCES OF VARIOUS REACTOR STRATEGIES. Decressin, A.; Haytinck, B.; Orlowski, S. (Commission of the European Communities, Brussels). Energ. Nucl. (Milan); 21: No. 4, 214-219(Apr 1974). (In French).

Some possible power reactor strategies (LWR with Pu recycling, LWR + FBR, LWR with Pu recycling + HTR) are considered and their influences on future nuclear fuel requirements are investigated. It appears from this study that in the year 2000 the installed nuclear capacity in the Community (nearly 1000 GWe) would imply the consumption of roughly 150,000 metric tons of natural uranium and require 90,000 tons of separative work for enriched uranium, whatever average strategy is considered for the period 1980–2000, taking into account in any case the necessity of utilizing the Pu produced. (auth)

8925 EFFECTS OF NUCLEAR ENERGY ON THE COSTS OF ELECTRICITY SUPPLY. Schmitt, D.; Arntzen, R. (Univ., Cologne). Kerntechnik; 16: No. 1, 11-17(Jan 1974). (In German and English).

The effects of nuclear energy on the costs of power supply are restricted to the generation field. There they are determined by the share of nuclear energy in supplying the power demand and the development of the cost relationships of power supply on a nuclear and a conventional basis. An analysis of the development of the main cost components leads to the conclusion that the cost advantage of power generated by nuclear energy will increase until the middle of the 1980's to about 1.6 Pf/kWh compared with power generated in oil fired stations. Taking into account the expected share of nuclear energy in power generation, a cost reducing effect on power supply of about 0.64 Pf/kWh can be expected by 1985. (GE)

8926 PLANUNG UND STANDORTWAHL VON KRAFTWERKEN. Konzeption der Stromversorgung der BRD Unter Beruecksichtigung der Umweltbeeinflussung. (Planning and Site Selection of Power Plants. Concept of the Generation of Electricity in the German Federal Republic Taking the Influence of the Environment Into Account). Buch, A. Mainz; Krausskopf (1973). 126p.

The future power and electric energy demands in the German Federal Republic, planning and site selection of future power plants, and the influences on environment as a function of the type of power plant and its location are described. (GE)

8927 PROSPECTS OF DEVELOPMENT OF NUCLEAR POWER FOR ELECTRICITY SUPPLY AND NUCLEAR INDUSTRY. Huenlich, W. H. F. (Vereinigung Deutscher Elektrizitaetswerke eV, Frankfurt am Main). At. Strom; 20: No. 1-2, 1-8(Jan 1974). (In German).

On the basis of the need for nuclear energy for power generation, a review is given of the present position and the development of nuclear energy in the Federal Republic of Germany. Special attention is paid to the installations which are in operation or in the planning stage and also to the problems which arise in electrical utilities. (GE)

8928 DEVELOPMENT OF NUCLEAR ENERGY IN CAPITALIST COUNTRIES. Makarov, V. S.; Chernyaev, V. A. At. Tekh. Rubezhom; No. 6, 3-6(Jun 1973). (In Russian).

The total output of nuclear power plants in the capitalist countries at the present consists of 34 million kW. An increase of the production of electrical energy can be increased by the introduction of new nuclear power plants and by an increase of the coefficient of utilization of established capacities of existing nuclear power plants. The future development of nuclear power will be based on LWR, HTGR, and FBR type reactors. The basic trends for the future development of these reactor types are explained. A significant increase of the economic indicators of nuclear power plants is necessary for the realization of these trends. The economic indicators considered are capital costs and cost of the production of electrical energy which will promote the very successful introduction of nuclear power plants into the power system. (tr-auth)

8929 CONSIDERATIONS CONCERNING THE DEVELOPMENT OF COSTS FOR NUCLEAR POWER PLANTS WITH LIGHT WATER REACTORS IN CAPITALIST COUNTRIES. Buhl, G. (Institut fuer Kraftwerke, Berlin, Ger.). Kernenergie; 17: No. 1, 11-15(Jan 1974). (In German).

The basic changes of both the total costs and the cost components in capitalist undertakings of generating electric power from nuclear energy are considered. Furthermore, some aspects of the economy of nuclear power plants are discussed as compared with conventional plants. Finally, the causes of cost changes are summed up and their effects on the economy of nuclear power plants are analyzed. 20 references. (auth)

8930 TECHNICAL AND ECONOMICAL ASPECTS OF ELECTRICITY GENERATION BY NUCLEAR POWER. Eitz, A. W. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Chem.-Ing.-Tech.; 46: No. 3, 88-91(Feb 1974). (In German).

From meeting of the German Chemistry Society "energy budget and electrical heat"; Ludwigshafen, Ger. (4 Oct 1973).

Based on an estimate of the primary energy demand, the share for the generation of electricity, as well as the share of nuclear energy in generation electricity for the FRG until 1985, and the most important trends in the development of nuclear energy are discussed. Problems such as economy, the demand for uranium, as well as of the development of advanced reactors are presented. (GE)

8931 EXPERIENCE IN THE OPERATION OF NUCLEAR POWER STATIONS AND IN FUEL SUPPLY. A Report on The Symposium of The International Atomic Energy Organization (IAEO) in Vienna. Koop, W.; Wolf, M. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). At. Strom; 20: No. 1-2, 8-10(Jan 1974). (In German).

Reactor Fuel Cycle Economics

Refer also to abstract 8919.

8932 SURVEY OF PLUTONIUM RECYCLING IN THE UNITED STATES. Brown, J. H.; Nilson, R. (Exxon Nuclear Co. Inc., Brussels). J. Brit. Nucl. Energy Soc.; 13: No. 2, 141-148(Apr 1974).

Recycling of Pu produced in light water reactors offers economic advantages combined with reduced demands for separative work for enrichment. Implementation of Pu recycling requires adequate evaluation of economic incentives, technical analysis of special problems, and an adequate basis for reactor licensing. The Pu recycle programme is reviewed with respect to each of these questions. Recycling of Pu is strongly indicated by economic forces. The fuel cycle fraction of power costs can be significantly reduced by Pu recycling, particularly when the costs for Pu inventories will be significant and contribute to the incentive for recycling. Plutonium recycling in self-generation amounts and for exposures normally associated with light water reactor operation represents only a minor change in reactor operation. Techniques are available today to evaluate and cope with the differences and past experience with Pu as the reactor fuel is very encouraging. No new safety problems are created by recycling and existing reactor safety factors are not significantly affected. Similarly, environmental impacts are not changed in a major way. Reviews of all these points for purposes of reactor licensing are currently under way in the US. Plutonium recycling will begin on a major scale in the US in 1977 and is expected to continue as a normal mode of operation in light water reactors until the advent of the fast breeder reactor late in this century. (auth)

Reactor Licensing and Regulation

Refer also to abstract 6594.

8933 (DEU-73-25) WASTE WATER FROM NUCLEAR POWER PLANTS. Aurand, K.; Arndt, J.; Ruehle, H.; Wolter, R. (Bundesgesundheitsamt, Berlin (F. R. Germany). Inst. fuer Wasser-, Boden- und Lufthygiene). 1972. 6p. (In German). INIS.

The uniform measurement regulations developed by the Federal Health Office and by the operators of nuclear power plants and the recommendations worked out for efficient discharge control are briefly discussed. (INIS)

8934 (DOCKET-STN-50481-1) BABCOCK AND WILCOX SAFETY ANALYSIS REPORT (B-SAR-241). Volume 1. (Babcock and Wilcox Co., Lynchburg, VA. (USA)). 10 May 1974. 445p. Dep. NTIS $25.25.

A reference PWR nuclear steam system with an initial rated core power level of 3800 MW(t) corresponding to a nuclear steam system thermal output of 3818 MW(t) and a corresponding net electrical power output of 1322 MW(e) is described. The NSS and its auxiliary systems are designed for an ultimate core power level of 4100 MW(t). The ECCS analysis and environmental consequences of accidents are evaluated for the ultimate core power level. The reactor core consists of UO_2 pellets enclosed in Zircaloy tubes. The mechanical control rods are clusters of stainless-steel-clad absorber rods, which move in guide tubes. The steam generators are integral economizers, once-through units incorporating pure counterflow heat transfer. (FS)

8935 (DOCKET-STN-50488-2) THOMAS L. PERKINS NUCLEAR STATION, UNITS 1, 2, AND 3. Cherokee Nuclear Station, Units 1, 2, and 3. License Application. (Duke Power Co., Charlotte, N. C. (USA)). 1974. 67p. (DOCKET-STN-50489-2; DOCKET-STN-50490-2; DOCKET-STN-50491-2; DOCKET-STN-50492-2; DOCKET-STN-50493-2). Dep. NTIS $6.50.

An application is submitted for construction permits for six power generating units. Three Perkins units, located in the southwest portion of Davie County, North Carolina on the Yadkin River, and three Cherokee units, located in the northeast portion of Cherokee County, South Carolina on the Broad River, are intended to be duplicates with the NSSS for each unit being a PWR furnished by Combustion Engineering Inc., using the CESSAR described in DOCKET-STN-50470 to describe the NSSS design. Containment is a spherical steel structure enclosed by a reinforced concrete reactor building. Closed cycle cooling towers are provided to disstpate heat discharged by the plant. Redundancy is provided in the Reactor Protection System and the Engineering Safety Features, so that no single failure of any active component can prevent action necessary to safe operation. Reactor core power level is rated at 3800 MW(t) with a rated net output of 3817 MW(t) which corresponds to a rated electrical output of 1280 MW(e). Major structures, systems, and components, including some safety analyses, are evaluated for a power level of 4018 MW(t) to provide a margin of conservatism above the rated power level. (FS)

8936 (FIND-50272) FIND: SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Items 1-96. Horn, F. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 31p. Dep. NTIS $4.00.

An index to microfiche issuances of safety analysis reports and other required documentation is provided. Subject citations are to specific frames on the microfiche. (JWR)

8937 (RAI-74-4) REGULATORY ADJUDICATION ISSUANCES AND ISSUANCES OF THE BOARD OF CONTRACT APPEALS, APRIL 1974. (USAEC Technical Information Center, Oak Ridge, Tenn.). May 1974. 571p. TIC $2.80.

The issuances received during April 1974 from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), and the Board of Contract Appeals (BCA) are presented. (auth)

8938 IEEE TRIAL-USE GUIDE FOR CLASS 1E CONTROL SWITCHBOARDS FOR NUCLEAR POWER GENERATING STATIONS. New York; Institute of Electrical and Electronics Engineers, Inc. (1973). 9p. (ANSI-N-41-17).

This document applies to all Class 1E control switchboards (for example, main control room assemblies, auxiliary panels, local panels or racks, etc) regardless of their application or location. It does not apply to the non-Class 1E control switchboards, except as they affect the Class 1E control switchboards, but recognizes that Class 1E control switchboards may be adjacent to, or joined with, other non-Class 1E control switchboards. This document includes, but is not necessarily limited to, design, construction, wiring practices, shipping, handling, storage, installation, testing, and quality assurance. General design practices which are not unique to Class 1E control switchboards are not addressed in this document. This document applies to piping systems and Class 1E equipment only as they may affect the integrity of the Class 1E control switchboard. (auth)

8939 IEEE TRIAL-USE STANDARD. Criteria for Separation of Class 1E Equipment and Circuits. New York; Institute of Electrical and Electronics Engineers, Inc. (1974). 12p. (ANSI-N-41-14).

The scope of this document is the physical separation of the circuits and equipment comprising or associated with the Class 1E power systems, Class 1E protection systems, and Class 1E equipment. This document sets forth criteria for the separation of circuits and equipment which are redundant but does not address the determination of what is to be considered redundant. (auth)

8940 REQUIREMENTS FOR AUDITING OF QUALITY ASSURANCE PROGRAMS FOR NUCLEAR POWER PLANTS. New York; American Society of Mechanical Engineers (1973). 18p. (ANSI-N-45-2-12).

This standard provides requirements and guidance for establishing and implementing a system of internal and external audits, including the preparation, performance, reporting, and followup of audits of quality assurance programs for nuclear power plants. The activities covered by this standard include designing, purchasing, fabricating, handling, shipping, storage, cleaning, erecting, installing, inspecting, testing, maintaining, repairing, and modifying of Nuclear Power Plants. (auth)

GENERAL

Energy Utilization and Economics

Refer also to abstract 6568.

8941 (UCRL-51533(Rev. 1)) SHALLOW SOLAR POND ENERGY CONVERSION SYSTEM: AN ANALYSIS OF A CONCEPTUAL 10-MWe PLANT. Clark, A. F.; Day, J. A.; Dickinson, W. C.; Wouters, L. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jan 1974. Contract W-7405-eng-48. 31p. Dep. NTIS $4.00.

A shallow solar pond system appears to be the most cost effective way to produce large scale electric power from solar energy. Water is used both for heat collection and heat storage. Inexpensive layers of weatherable transparent plastic over the water suppress heat loss to the environment. The hot water is stored in an insulated reservoir at night and during bad weather. The stored hot water heats a thermodynamic fluid, such as Freon 11, which drives a turbine and an electric generator. A shallow solar pond system can be built using materials, fabrication techniques, and geometries that are presently used on a large scale in U. S. industry. A 10 MWe plant built in the Southwest would require a total area of about 2.5 km^2 (~1 mi^2) and could provide power for a community or a manufacturing process. The estimated busbar cost of electricity (in 1973 dollars) for a shallow solar pond system, which could come on line in as short a time as 5 to 7 years, is 27 mills/kWh. It is projected that this cost could be reduced by almost half with the development of improved and cheaper plastics and more efficient turbines. (auth)

Information Handling

8942 (CONF-740424-3) MATERIALS INFORMATION SERVICES OF THE ENVIRONMENTAL INFORMATION SYSTEM OFFICE AND THE TOXIC MATERIALS INFORMATION CENTER. Copenhaver, E. D.; Ulrikson, G. U. (Oak Ridge National Lab., Tenn. (USA)). 1974. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

From materials information programs meeting; Gaithersburg, Maryland, USA (16 Apr 1974).

The Environmental Information System Office offers to users bibliographic references, factual information, numerical data, and evaluated reviews of data in and for all of the major environmental research areas active at Oak Ridge National Laboratory: energy, trace contaminants, human health, environmental impact, radiation research, land use and planning, ecosystems modeling, and analysis. The Toxic Materials Information Center is a materials-oriented center dealing with trace contaminants in the environment with particular emphasis on metals and organometallic compounds. (auth)

8943 (LA-5600-MS) PUBLICATIONS OF LASL RESEARCH, 1972. Kerr, A. K. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 261p. Dep. NTIS $7.60.

The bibliography cites unclassified publications of the Los Alamos Scientific Laboratory for 1972. Subjects covered are aerospace science, chemical analysis, astrophysics, atomic and molecular physics, biology and medicine, chemical dynamics, chemistry, cryogenics, crystallography, plasma physics, earth sciences, engineering, EPR, ESR, NMR, explosives, fission physics, health and safety, hydrodynamics and radiation transport, instruments, lasers, mathematics, computers, metallurgy, ceramics, neutronics, nuclear physics, safeguards, reactor technology, and solid state physics. (SFL)

8944 (ORNL-4943) AEC/RECON USER'S MANUAL. Gilcrist, J. A. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 85p. Dep. NTIS $5.45.

Instructions are given for operating AEC/RECON, a computerized information retrieval project of the Atomic Energy Commission designed to allow the user to browse through large files of document citations to find those he is interested in. Information, such as titles, authors, and keywords from Nuclear Science Abstracts and a variety of other bibliographic data bases, including non-nuclear energy data, is stored in the computer at Oak Ridge National Laboratory. This information can be selectively retrieved by simple commands typed at one of several keyboard terminals scattered at various locations about the U. S. The dialog between the user and the computer is carried on over a TV screen and the results of the search can be printed later. The system has proven fairly popular as an information retrieval tool. The commands are easy to learn. The response of the system is rapid, usually within a few seconds. Portions of the index can be easily displayed and saved. Commands are available for "refining" the search request by combining selected sets of citations inclusively or exclusively. At each step the number of items meeting the selection criteria is displayed. Retrieval may be based on such fields as keywords, authors, countries, corporate codes, journal codens, etc., or combinations of such fields. (auth)

Law

8945 CONSEQUENCES OF WATER LEGISLATION UPON THE UTILIZATION OF NUCLEAR ENERGY. Fischerhof, H. (Univ., Bonn). pp 81-91 of Indirekte Massnahmen Zum Schute der Gewaesser, Insbesondere die Erhebung von Abwasserabgaben. Cologne; Heymanns (1973).

A general review of the basic German federal provisions for the protection of water is provided. Different aspects of this problem are discussed, especially the predominance of water protection, particularly of drinking water; the authorization or approval of the utilization of water, as well as some organizational problems. Finally, the limits and the close interrelationship between the atomic energy and the water laws are considered. The fact that atomic energy and water legislation must not and cannot be controversial is emphasized. (GE)

Management

8946 (TID-3344) DECOMMISSIONING OF NUCLEAR FACILITIES: A BIBLIOGRAPHY. (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 11p. Dep. NTIS $4.00.

The bibliography contains 108 references dealing with the decommissioning, retirement, or dismantling of various nuclear facilities. References were selected from NSA, and are arranged chronologically. (SFL)

8947 ONTWIKKELINGSPLAN 74-77. (Development Plant for 1974-1977). Houtman, J. P. W.; van Loef, J. J.; Boersma, J. Amsterdam; Interuniversitair Reactor Instituut ([nd]). 92p.

An overview is presented of projected activities of the Reactor Center for the next few years. Projects include research reactor and electron accelerator work, space requirements, costs, and radiation chemistry and physics problems. (TSS)

Mathematics and Computers

8948 (ANL-7400(Suppl. 8)) ARGONNE CODE CENTER: COMPILATION OF PROGRAM ABSTRACTS. Butler, M. K.; Edwards, H. S.; Harrison, C. Jr.; Hughes, C. E.; Legan, M.; Menozzi, T.; Ranzini, L.; Snow, W. J. (Argonne National Lab., Ill. (USA)). Feb 1974. Contract W-31-109-eng-38. 519p. Dep. NTIS $13.60.

This publication is the eighth supplement to and revision of ANL-7411. It contains a revised cover, title page, and table of contents; revisions to the sections on History and acknowledgments, Abstract format, Recommended program package contents, and Program classification guide and thesaurus; revised ACC abstracts; additional abstracts; revised sections on the Library programs by classification and KWIC index; and a replacement for the references section. (RWR)

8949 (BNWL-SA-4984) SOUSA: A ROOT FINDER FOR NONLINEAR EQUATIONS. Oster, C. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1974. 25p. (CONF-740511-5). Dep. NTIS $4.25.

From mathematical software II conference; Lafayette, Indiana, USA (29 May 1974).

8950 (CONF-730942-P5, pp vp Paper M 4/2) OPTIMAL METHOD FOR COMPUTING EIGENVECTORS USING THE INVERSE POWER TECHNIQUE. Rosen, R. (Mechanics Research Inc., Los Angeles). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The inverse power method of eigenvalue/eigenvector extraction is ideally suited to large structural dynamic analysis computer programs. Many of the computer codes currently available to the engineering community are successfully employing this technique. The particular method described has been successfully employed in the MRI/STARDYNE Structural Analysis System. The basic method as well as the extraction of close roots has been presented by Rosen and Rubinstein ("Dynamic Analysis By Matrix

Decomposition", ASCE, Journal of Engineering Mechanics Division, V. 94, NEM 2, pp. 385-395) in April 1968. The nature of the assumed eigenvector as it changes during the iteration process is examined. Making use of the multiple eigenvector extraction method (as present in "Dynamic Analysis by Matrix Decomposition") and prescribing a convergence criterion of N significant digits in the "to be computed" eigenvector an equation is derived to compute the number of iterations required to reach convergence. At this point an algorithm is formulated to extract the eigenvalues/eigenvectors using a minimum amount of computer time. This algorithm uses the number of iterations required for convergence as well as the computer times associated with different phases of the inverse power method to internally decide when to cease iterating at the current shift point and move to the next shift point. Using the information determined during the current iteration the algorithm also decides on the location of the next shift point. By utilizing this technique the program user is no longer burdened with the "a priori" decisions of shift point selection and the number of iterations to be attempted. (auth)

8951 (CONF-730942-P5, pp vp Paper M 4/3) EIGENCOMPUTATION OF SYMMETRIC HYPERMATRICES USING A GENERALIZATION OF THE HOUSEHOLDER METHOD. Braun, K. A.; Johnsen, T. L. (Univ., Stuttgart). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The majority of dynamic response calculation is based on modal analysis requiring the computation of mode shapes and frequencies of complex structures. Basically, there are two types of methods: (1) Direct methods which involve a finite number of similarity transformations to obtain a tridiagonal form for which eigenvalues and eigenvectors are found by iterative techniques. (2) Iterative methods which now are predominantly operating with subspace concepts to obtain eigenvectors and eigenvalues. When we need many of the natural modes, iterative methods become inefficient for large scale problems. An alternative method is to reduce the problem size by static condensation and to apply a direct method for finding eigenvalues and eigenvectors. A method which is particularly suited for problems of an order between 100 and 1000 degrees of freedom after static condensation is discussed. With one exception, algorithms are used which are compatible with the Hypermatrix philosophy wherein the out-of-core matrix is divided in so-called submatrices on which in-core operations are performed. The scheme provides an optimum balance between central processing and data transfer independent of problem size. Furthermore, the core storage requirements are also independent of problem size except for a few restrictions of less practical importance. The major steps of the algorithm are described. The set of eigenvectors is constructed such that K-orthonormality will be achieved to working accuracy of the computer. After the presentation of the algorithm its computational effort is assessed in regard to the number of operations and IO data transfer. The operation count considers such parameters as: n_0, b_0—the order and bandwidth of the uncondensed matrices K_0 and M_0, n_c—the order of the condensed problem, n_x—the number of desired eigenvectors, n_s—the order of submatrices. In conclusion, the method is illustrated on some examples for which computation times are compared with those of an iterative method using simultaneous subspace iteration. (auth)

8952 (CONF-730942-P5, pp vp Paper M 8/5) THEORETICAL DETERMINATION OF THE PROBABILITY DISTRIBUTION OF AVAILABLE POWER OF A SYSTEM OF POWER STATION UNITS. Trautmann, K. (Technische Hochschule, Darmstadt, Ger.). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In order to come to a decision on capacity reserve of a system of power station units we must know the reaction at operation and failure of the single unit. Its reaction is dependent on determined factors as scheduled outages and random variables as forced failures and operating periods. Only those last variables will be taken into consideration. In literature it is explicitly or implicitly assumed that the sequence of operating and failure periods are independent and that they occur exponentially distributed. On the basis of this assumption the probability distribution of available power of a system of power station units (DAP) is generally determined. The examination of the operating and failure periods of ten units, however, has shown that this assumption can only be upheld for the operation times while the failure time can be more exactly described by a combination of exponential and logarithmic normal distribution. Thus the methodical basis of procedures proposed in the past is taken away. In order to analyze the different effects of the alternative use of both distribution types of the failure time upon the DAP a simulation model was developed. Its deviation was so marginal that it henceforward justifies to use the exponential distribution. The advantage consists in its being handled more easily. Now we must ask whether the DAP will be determined better analytically or by simulation as far as accuracy, computer time and memory are concerned. Formerly proposed approximation procedures turned out to be too inexact. By analytical determination of the DAP we understand: Given n units with the power x_i and the probability of failure q_i, $i = 1,2,..,n$. Principally there are 2^n available power values of the system of n units 0, x_1,..., x_n, $x_1 + x_2$ etc. with the corresponding probabilities $q_1q_2...q_n$ $(1-q_1)q_2...q_n$ etc. The expenditure of calculation is considerable. An algorithm, however, has been found, computing recursively the DAP and limiting the number of necessary operations to a tolerable extent. It needs for $n = 100$ only 350 sec on an older machine (IBM 7040). The simulation procedure requires much more time. The cut-off criterion was defined in the following way: the absolute deviation should not be greater than 0.005 over a simulation period of ten years. Thus the simulated process ran over 29 years at for instance $n = 9$ and needed twelve minutes of computer time. Even after 100 years the deviation from the DAP that had been analytically determined still amounted to 0.016 in the highest class. On the other hand a simulation model permits mapping the whole operation of a power system. Thus one can study the effect of system interruption and similar problems by parametrically varying the load. (auth)

8953 (CONF-730942-P6B-S, pp vp Paper M 1/3) SOME ORGANIZATIONAL ASPECTS OF NASTRAN. MacNeal, R. H. (MacNeal-Schwendler Corp., Los Angeles). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

NASTRAN is a large digital computer program for static and dynamic structural analysis by the finite element approach. NASTRAN was initially conceived as, and to a degree has become, an integrated, general purpose structures program with a wide spectrum of users, but with primary emphasis on aerospace applications. The paper reviews two aspects of the organization of NASTRAN: first, the objectives and specifications initially set for the program and the technical functions performed internally to achieve them; and, second, the relationships between the groups of people involved in the planning, development and distribution of NASTRAN. The development of NASTRAN began with the activities of a NASA committee which decided, in 1964, that a new computer program should be written to satisfy needs for structural analysis. The original objectives for NASTRAN with respect to types of analysis, methods of analysis, problem size, computer types, user conveniences, maintainability, are reviewed and specific features of the program relating to the objectives are discussed. Attention is paid to the executive system, which is the main instrument of program organization and which controls the sequence of operations, manages the secondary storage files, and maintains a restart capability. Problem solution functions are performed by independent subprograms, called functional modules, which may be entered only from the executive system. The history of NASTRAN in terms of the functions and achievements of the participating government and industrial agencies is reviewed. Additions and improvements subsequent to the initial development, and plans for future developments, are described. The present organizational structure for planning, developing and distributing NASTRAN is outlined, and its effectiveness is evaluated in terms of the initial objectives and in terms of the present needs of various user groups. (auth)

8954 (CONF-730942-P6B-S, pp vp Paper M 2/1) SOME CONSIDERATIONS FOR THE EVALUATION OF FINITE ELEMENT MODELS. Argyris, J. H.; William, K. J. (Univ., Stuttgart). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An assessment of the present state of the art of finite element discretisation techniques is made. There are a number of factors which affect the performance of individual elements in stress-analysis: (1) Variational Formulation (Basis of displacement, stress and mixed models). (2) Modal Functions (Element interpolation of independent field variables). (3) Geometric Mapping of Element Functionspace (Transformation between homogeneous and global coordinates). (4) Numerical Integration of Energy Density (Evaluation of element properties). (5) Inter-element Continuity (Compatibility of independent field variables across element boundaries). After a critical appraisal of these effects on the element behavior, the investigation on compatible displacement models was studied. Some concepts of bounding the discretization error are critically reviewed and assessed in regard to their practical usage. Then, appropriate numerical

methods are developed to measure energy contributions of different finite element models with eigenvalue techniques for both, the element level as well as the structural level. Several examples are given in which these concepts are applied to investigate effects such as the choice of modal functions, the distortion due to non-linear mappings, and the order of numerical integration schemes. (auth)

8955 (CONF-730942-P6B-S, pp vp Paper M 3/7) TRIANGULAR THICK SHELL FINITE ELEMENT FOR THE THREE-DIMENSIONAL STRESS ANALYSIS OF PRESSURE VESSELS. Ramani, D. T. (Babcock-Brown Boveri Reaktor GmbH, Mannheim, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A finite-element method of analysis, based on an exact elasticity solution, including transverse shearing deformation capability was developed for the application to the bending of plates and shells of any arbitrary configuration. The field equations of Reissner's thick-plate theory, which includes the effects of transverse shearing deformation were utilized as guidelines in developing a triangular thick shell flat element for a three-dimensional stress analysis. The formulation of an orthotropic element, having six nodal points (3 each at top and bottom), was modeled herein on the basis of trilinear displacement functions. The element dealt with possesses 36 degrees of freedom (3 rotations and 3 displacements at each node) which represent both membrane and bending (including shearing) deformations. Whereas shearing deformation is coupled with the bending mode, the membrane behavior is considered independent of bending and shearing for simplicity of computations. The procedure for including the shear effects is somewhat similar to other known elements, however, with some fundamental differences, such as the retention of all the components of the strain tensor, $\{\epsilon\}^e$, for the stiffness matrix generation and treatment of proper boundary conditions along an edge. The method presented is consistent with Reissner's assumption of linear bending stress distribution and considers the nodal displacements at the top and bottom, in a bending mode, to vary linearly over the thickness of the plate. However, the transverse displacement does not vary over the thickness of the plate. Further simplification in the development of stiffness matrix occurs, when the bending mode is assumed to be simulated by an antisymmetric deformation of top and bottom sets of nodes in the element about its middle plane and transverse displacement, is assumed identical at all the nodes. To test the validity of the proposed analysis, results are compared with those of the Reissner theory and other example problems in plates and shells. An excellent agreement in displacements and tractions was obtained. The ability of the finite-element analysis, based entirely on a displacement formulation, satisfies the edge conditions and accurately represents the distribution of shear stress results along an edge. (auth)

8956 (CONF-730942-P6B-S, pp vp Paper M 4/1) COMPUTATIONAL TECHNIQUES FOR FINITE ELEMENT ANALYSIS. Melosh, R. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A critical review of computational techniques for finite element analysis is provided and the set of ideas which could form the basis for advanced software is discussed. A state-of-the art computer program which is a realization of the better ideas described in the literature is provided. In the course of this development documented techniques for expediting analysis, controlling accuracy, and automating tedious tasks of numerical analysis in structural mechanics were reviewed. Computational methods are considered for automating development of mesh data, establishing the sequence of equation treatment; developing element models; predicting equilibrium, resonance, and transient behavior; evaluating secondary unknowns; and describing analysis results. It encompasses "exact" analysis procedures and describes approximate methods successfully used in reducing computer processing costs. The collage of ideas identifies omissions of valuable computation techniques. These pertain to insuring meeting the user's objectives of relevance of the analysis and automation of computational details. The ideas center around the concept of self-validation of simulations and automatic control of discretization error. Incorporation of these ideas is viewed as the necessary step in obtaining the next order of magnitude increase in application of finite element technology. (auth)

8957 (CONF-730942-P6B-S, pp vp Paper M 8/3) GENERALIZATION OF THE EXPRESSIONS FOR THE RELIABILITIES AND AVAILABILITIES OF A REPAIRABLE ITEM. Birolini, A. (Eidgenoessische Technische Hochschule, Zurich). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An item is a hardware assembly of an arbitrary complexity; that is, a system, subsystem, equipment, component, part, etc. The item is considered repairable if, at each failure, it can be restored in such a way that it is again able to perform its required function. Failure-free and repair times are obviously non-negative random variables. The stochastic behavior of such a repairable item is generally investigated by assuming that it alternates uninterruptedly from the operating state (up) to the repair state (down) and conversely, failure-free and repair times are statistically independent, after each repair the item is like new, at $t = 0$ the item, enters the operating state. The study of the stochastic behavior of a repairable item, at $t = 0$ the item is, with a probability α, in the operating state (up), with a probability $1 - \alpha$, in the repair state (down); furthermore the distributions of the first failure-free time, or repair time, (counted from $t = 0$) are $F_A(x)$, or $G_A(x)$ respectively, and to clarify and correct, with the help of this generalization, some of the misleading developments recently introduced into the literature on reliability (specially into the literature devoted to nuclear engineering problems). A tutorial exposition of some basic results of renewal theory is given, and the concept and the main properties of the renewal process and of the alternating renewal process are introduced. The study of the stochastic behavior of a repairable item is performed by using two modified alternating renewal processes. This approach allows the immediate generalization of the expressions for the reliabilities and availabilities. Care must be taken in the uncritical use of some of the results given by a novel method, recently proposed for the analysis of complex repairable systems, and which is apparently finding a wide use in the reliability prediction of nuclear plants. This method introduces two new concepts for failure and repair rates, and performs a fault tree evaluation with the help of a Markov approach. Although such a Markov approach is basically correct, it is rather problematic in its use. In fact, some of the results that have been found by using this method uncritically are erroneous in the general case (of non exponential failure-free and repair times). (auth)

8958 (COO-3077-50) METHOD OF ARTIFICIAL COMPRESSION. I. Shocks and Contact Discontinuities. Harten, A. (New York Univ., N.Y. (USA). AEC Computing and Applied Mathematics Center). Jun 1974. Contract AT(11-1)-3077. 130p. Dep. NTIS $9.50.

8959 (KFK-EXT-8-74-1) GUIDE FOR EXTENDING THE GRAPHIC SYSTEM. Enderle, G.; Schlechtendahl, E. G.; Schuster, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Feb 1974. 62p. (In German). Dep. NTIS (US Sales Only) $6.25.

8960 (KFK-EXT-13-74-1) MACROPROCESSOR STAGE 2: GENERATION PROCEDURE AND PROGRAMMER'S GUIDE. Fichtel, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Datenverarbeitung in der Technik). Apr 1974. 54p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

8961 (KFK-PDV-16) INTERRUPT PRIMITIVES FOR PROCESS CONTROL SYSTEMS. Hilse, D. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). Nov 1973. 46p. (In German). Dep. NTIS (US Sales Only) $5.50.

8962 (KFK-PDV-18) HARDWARE EXTENDED EXECUTIVE PRIMITIVES FOR PROCESS CONTROL SYSTEMS. Synchronization Primitives (4th Intermediate Report). Eggenberger, O. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany)). Jan 1974. 32p. (In German). Dep. NTIS (US Sales Only) $4.75.

Executive primitives for the access synchronization to shared data and for the synchronization caused by events used to coordinate parallel processes are described. (tr-auth)

8963 (ORO-3443-49) NONUNIFORM ERROR ESTIMATES FOR THE FINITE ELEMENT METHOD. Babuska, I.; Kellog, R. B. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Apr 1974. Contract AT(40-1)-3443. 16p. (BN-790). Dep. NTIS $4.00.

8964 NUMERICAL 2D- AND 3D-SOLUTION OF THE STATIONARY FOURIER HEAT CONDUCTION EQUATION FOR SOLIDS. Ehnis, L. Stuttgart; Univ. Stuttgart (1973). 110p. (In German). (IKE-4-19).

Thesis.

Miscellaneous

8965 (BDX-613-1078) RESOURCES FORECASTING SYSTEM. Technological Spinoff Report. Kolich, J. J. (Bendix

Corp., Kansas City, Mo. (USA)). Mar 1974. Contract AT(29-1)-613. 43p. Dep. NTIS $4.00.

8966 (CEA-CONF-2561) MOORED OBSERVATION BALLOON AND MEASUREMENTS AT 6,000 METERS. Perroud, P.; Robuchon, A.; Sylvestre-Baron, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Oct 1973. 13p. (In French). (CONF-731138-3). Dep. NTIS (US Sales Only) $4.00.

From AERALL colloquium; Paris, France (12 Nov 1973).

It is possible to adapt a classic 10,000 m^3 Aerazur moored balloon with an expandable keel to flight conditions at 6,000 m altitude. In order to do this three air bags with a total volume of 4,500 m^3 are introduced into the keel; they can be progressively deflated to compensate for the volume variation. The steel or fiber glass mooring cable has copper wire attached for the electrical power of the gondola. (tr-auth)

8967 (COO-1199-31) METROMEX 1973: A SUMMARY OF OPERATIONS CONDUCTED BY ATMOSPHERICS INCORPORATED DURING THE PERIOD 7 JULY–19 AUGUST 1973. Henderson, T. J.; Duckering, D. W. (Atmospherics, Inc., Fresno, Calif. (USA)). 30 Dec 1973. Contract AT(11-1)-1199. 53p. Dep. NTIS $5.75.

For Illinois State Water Survey, Urbana, IL.

Project Metromex is a large-scale investigation of inadvertent weather modification in an urban area, sited at St. Louis. Operations performed during July 7 through 19 August 1973 for the Illinois State Water Survey are reported and included rainwater sampling, aircraft-released chemical tracer studies of clouds and air mass movements, air sampling and analysis, and both aircraft-obtained and radiosonde data from temperature, moisture, and particulate concentration measurements in the atmosphere. (LCL)

8968 (COO-1199-34) SUMMARY REPORT OF METROMEX STUDIES, 1971–1972. Huff, F. A. (ed.). (Illinois State Water Survey, Urbana (USA)). 1973. 173p. Dep. NTIS $11.75.

Metromex is a large-scale investigation of inadvertent weather modification in an urban area, sited at St. Louis. Analyses to date from 2 years of data collected in the 5-year Metromex field program are summarized. It includes extensive climatological-statistical analyses of rainfall and severe weather events and partial analyses for various atmospheric studies for which data are as yet limited. The 2-year results provide evidence that rain, thunderstorms, and hail maximize at locations 10 to 15 miles downwind of the urban-industrial region. These locations had more storms that were more intense, lasted longer, and produced greater amounts of rain and hail. Results also show that the atmosphere modified by heat and various emissions in the urban area does move up to levels where it can affect clouds and that the urban-modified atmosphere acts to invigorate convective storms and to increase the efficiency of precipitation events. Data and conclusions in this 2-year report provide a variety of information on urban effects on weather not obtainable in existing literature. (auth)

8969 (COO-1199-36) 1973 OPERATIONAL REPORT FOR METROMEX. Lowry, W. P. (Illinois State Water Survey, Urbana (USA)). Dec 1973. 65p. Dep. NTIS $6.25.

Project Metromex is a large-scale investigation of inadvertent weather modification in an urban area, sited at St. Louis. The research is being conducted by a federation of individual scientists from agencies interested in the effects of urbanization on precipitation-related processes. The 1973 operations by the following member agencies are reported: Argonne National Laboratory, Battelle Pacific Northwest Laboratories, University of Chicago, Illinois State Water Survey, Stanford Research Institute, and the University of Wyoming. Most of these operations involved obtaining information on atmospheric conditions using radiosondes, aircraft, and earth surface measurements of rainfall, meteorological conditions, and the particulate matter in air samples. (LCL)

8970 (JUL-996-MA) REPRESENTATION OF FUNCTIONS OF SEVERAL VARIABLES BY POINT SETS. Neunzert, H.; Wick, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentral. istitut fuer Angewandte Mathematik). Aug 1973. 47p. (In German). Dep. NTIS (US Sales Only) $5.60.

The fundamental definitions of the theory of asymptotic distributions are interpreted in terms of an approximation of functions by point sets. General integration rules are given, and the applicability of the theory to the numerical solution of linear partial differential equations of first order is shown. Besides, this theory is a valuable tool for the treatment of integro-differential equations like the Boltzmann-Vlasov equation. (GE)

8971 (P.A.U.M-23) ROLE OF R AND D IN COST/BENEFIT OPTIMIZATION SITUATIONS. Taylor, K. (Programmes Analysis Unit, Chilton (UK)). Jan 1974. 7p. Dep. NTIS (US Sales Only) $4.00, UK 50 pence.

8972 (UCRL-75495) INITIAL VALIDATION STUDIES FOR ZAM2 RADIATION AND LARGE-SCALE EDDY TRANSPORT MECHANISMS. Luther, F. M.; MacCracken, M. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Feb 1974. 40p. (CONF-740223-1). Dep. NTIS $5.00.

From 3rd conference on the climatic impact assessment program; Cambridge, Massachusetts, USA (26 Feb 1974).

The second generation zonal atmospheric model has been undergoing intensive development and validation in order to prepare it for assessing the climatic impact of the stratospheric injection of trace species by high altitude aircraft. Utilization is now made of Stone's parameterization for the vertical and horizontal eddy fluxes in the troposphere and Luther's values of the eddy diffusion coefficients in the stratosphere. Trace species transport is included for both radiatively active and passive species. The radiation prescription has been improved to treat ozone absorption based on the amount of ozone present. Model validation will include comparison with climatic data and other modeling efforts as well as sensitivity studies of various modeled processes. Application of this model to the Climatic Impact Assessment Program will involve studying the effects of injection of aerosols, reduction in stratospheric ozone heating, and possible perturbations resulting from water vapor injection. (auth)

Chemistry

8973 (SLA–74-192) X-RAY SIMULATION WITH LIGHT-INITIATED EXPLOSIVE. Mathews, F. H.; Benham, R. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1974. Contract AT(29-1)-789. 5p. Dep. NTIS $4.00.

Life Sciences

8974 (BNWL-tr-113) POPULATION OF INTRA-ALVEOLAR MACROPHAGES IN THE LUNG OF THE RAT: CYTOLOGIC AND CYTODYNAMIC STUDY UNDER DIFFERENT PHYSIOLOGIC AND PATHOLOGICAL CONDITIONS. Sedaghat, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 29 Apr 1974. Translation of CEA-R–4259. 79p. Dep. NTIS $7.00.

Thesis. Submitted to Paris Univ., Orsay, France.

8975 (CALT–767-P-6-X-9) STUDIES IN DEVELOPMENTAL IMMUNOGENETICS. Annual Progress Report. Owen, R. D. (California Inst. of Tech., Pasadena (USA). Div. of Biology). 25 Mar 1974. Contract AT(04-3)-767. 16p. Dep. NTIS $4.00.

8976 (CONF-731216–1) INTRACELLULAR TURNOVER OF AN ALTERED ENZYME. Johnson, R. W.; Kenney, F. T. (Oak Ridge National Lab., Tenn. (USA)). 1973. 6p. Dep. NTIS $4.00.

From Conference on intracellular protein turnover; Stanford California, USA (10 Dec 1973).

8977 (CONF-740425-2) TRANSFORMATION IN HAEMOPHILUS INFLUENZAE. LeClerc, J. E.; Setlow, J. K. (Tennessee Univ., Oak Ridge (USA). School of Biomedical Sciences; Oak Ridge National Lab., Tenn. (USA)). 1974. 39p. Dep. NTIS $5.00.

From symposium on mechanisms in recombination; Gatlinburg, Tennessee, USA (1 Apr 1974).

8978 (CONF-740441–1) STUDIES OF THE CONFORMATION AND SELF-ASSOCIATION OF CYCLIC DECAPEPTIDES BY TRIPLET–TRIPLET ENERGY TRANSFER. Beyer, C. F.; Craig, L. C.; Gibbons, W. A.; Longworth, J. W. (Rockefeller Univ., New York (USA); Oak Ridge National Lab., Tenn. (USA)). 1974. 22p. Dep. NTIS $4.25.

From international conference on excited states of biological molecules; Lisbon, Portugal (18 Apr 1974).

8979 (CONF-740441–2) LUMINESCENCE OF MODEL INDOLE-DISULPHIDE COMPOUNDS. Longworth, J. W.; Helene, C. (Oak Ridge National Lab., Tenn. (USA)). 1974. 20p. Dep. NTIS $4.00.

From international conference on excited states of biological molecules; Lisbon, Portugal (18 Apr 1974).

8980 (CONF-740441–3) FLUORESCENCE ANISOTROPY SPECTRA OF PROTEINS AND ENERGY TRANSFER. Longworth, J. W.; Ghiron, C. A. (Oak Ridge National Lab., Tenn. (USA)). 1974. 27p. Dep. NTIS $4.50.

From international conference on exicted states of biological molecules; Lisbon, Portugal (18 Apr 1974).

8981 (CONF-740441–4) UNIFIED APPROACH TO EXCITED STATE HOMOTRANSFER IN BIOLOGICAL SYSTEMS. Pearlstein,

R. M.; Lindenberg, K.; Hemenger, R. P. (Oak Ridge National Lab., Tenn. (USA); California Univ., La Jolla, San Diego (USA). Dept. of Chemistry). 1973. 26p. Dep. NTIS $4.50.
From international conference on excited states of biological molecules; Lisbon, Portugal (18 Apr 1974).

8982 (CONF-740525-1) EXTENT OF METHYLATION AND THE BIOLOGICAL ACTIVITY OF PHENYLALANINE tRNA. Shugart, L.; Stulberg, M. P. (Oak Ridge National Lab., Tenn. (USA)). 1974. 22p. Dep. NTIS $4.25.
From international symposium on the biochemistry of adenosylmethionine; Rome, Italy (21 May 1974).

8983 (COO-1801-35) PROTEIN SYNTHESIS IN DELAYED IMPLANTING MOUSE OVA. Final Report, September 1, 1973-December 31, 1973. (Kansas Univ., Kansas City (USA). Medical Center). 1973. Contract AT(11-1)-1801. 2p. Dep. NTIS $4.00.

8984 (COO-3115-11) GENETICAL AND DEVELOPMENTAL STUDY OF A COMPLEX LOCUS IN THE HOUSE MOUSE. Technical Progress Report, April 1, 1973-March 31, 1974. Dunn, L. C.; Bennett, D. (Columbia Univ., New York (USA)). 1974. Contract AT(11-1)-3115. 17p. Dep. NTIS $4.00.

8985 (COO-3214-6) PROGRESS REPORT ON RESEARCH ON HUMAN GENETICS IN ICELAND. (Iceland Univ., Reykjavik). 30 Apr 1974. Contract AT(11-1)-3214. 50p. Dep. NTIS $5.50.

8986 (COO-3233-2) SOME ASPECTS OF THE MECHANISM OF BACTERIOPHAGE FUNCTION. Progress Report, September 1, 1972-February 20, 1974. Freifelder, D. (Brandeis Univ., Waltham, Mass. (USA)). 1974. Contract AT(11-1)-3233. 9p. Dep. NTIS $4.00.

8987 (COO-3264-9) INBORN ANEMIAS IN MICE. Progress Report, May 1, 1973-April 30, 1974. Russell, E. S.; Bernstein, S. E. (Jackson Lab., Bar Harbor, Maine (USA)). 1 May 1974. Contract AT(11-1)-3264. 32p. Dep. NTIS $4.75.

8988 (SAN-779-4) FACILITATION OF TRANSPLANTATION BY SERUM FACTORS. Progress Report, July 1, 1973-March 31, 1974. Feldman, J. D. (Scripps Clinic and Research Foundation, La Jolla, Calif. (USA). Dept. of Experimental Pathology). 1974. Contract AT(04-3)-779. 7p. Dep. NTIS $4.00.

8989 (UR-3490-498) BIOLOGICAL TECHNIQUES. Coleman, J. R.; Mizuhira, V. (Rochester Univ., N.Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 10p. (CONF-730999-1). Dep. NTIS $4.00.
From meeting of electron probe analytical; Honolulu, Hawaii, USA (Sep 1973).

Materials

8990 (BDX-613-952) LINEAR THERMAL EXPANSION OF FILLED EXPOXY RESINS. McIlroy, H. M. (Bendix Corp., Kansas City, Mo. (USA)). Mar 1974. Contract AT(29-1)-613. 53p. Dep. NTIS $5.75.

8991 (BDX-613-980(Rev.)) PROFILE MILLING. Gillespie, L. K. (Bendix Corp., Kansas City, Mo. (USA)). May 1974. Contract AT(29-1)-613. 61p. Dep. NTIS $6.25.

8992 (BDX-613-981(Rev.)) MODIFIED PAPER HONEYCOMB AS AN ENERGY ABSORBER. Jackson, L. C. (Bendix Corp., Kansas City, Mo. (USA)). May 1974. Contract AT(29-1)-613. 16p. Dep. NTIS $4.00.

8993 (BDX-613-1015(Rev.)) MAGNET-WIRE STRIPPING. Final Report. Kirk, W. J. (Bendix Corp., Kansas City, Mo. (USA)). May 1974. Contract AT(29-1)-613. 34p. Dep. NTIS $4.00.

8994 (BDX-613-1026(Rev.)) REMOVING INSULATION FROM ALUMINUM MAGNET WIRE. Hollar, D. (Bendix Corp., Kansas City, Mo. (USA)). May 1974. Contract AT(29-1)-613. 8p. Dep. NTIS $4.00.

8995 (BDX-613-1069(Rev.)) MINIATURE-INTERCONNECTION PROCESSING. Hollar, D. L. (Bendix Corp., Kansas City, Mo. (USA)). May 1974. Contract AT(29-1)-613. 12p. Dep. NTIS $4.00.

8996 (BDX-613-1117) STATE-OF-THE-ART OF GENERAL DEBURRING METHODS. Ajlouny, N. S.; Gillespie, L. K. (Bendix Corp., Kansas City, Mo. (USA)). [nd]. Contract AT(29-1)-613. 76p. (CONF-740445-1). Dep. NTIS $7.00.
From SME international tool and manfacturing show conference; Philadelphia, Pennsylvania, USA (29 Apr 1974).

8997 (KAPL-M-7352) BRIEF SURVEY OF THE LATTICE STATICS METHOD. Brudnoy, D. M. (Knolls Atomic Power Lab., Schenectady, N. Y. (USA)). Dec 1973. Contract W-31-109-Eng-52. 39p. Dep. NTIS $5.00.

8998 (LA-tr-74-12) INTERACTION OF ALUMINUM OXIDE WITH CARBON AT 2000 TO 2400°C. Eliutin, V. P.; Paviov, Yu. A.; Chelnokov, V. S. Translated by A. D. Cernicek from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; 15: No. 4, 43-46(1972). 10p. Dep. NTIS $4.00.

8999 (MHSMP-73-41) HNAB QUALIFICATION USING MDF CONFIGURATION. Lichte, H. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 4p. Dep. NTIS $4.00.
For Sandia Labs., Albuquerque, NM.

9000 (MHSMP-73-43-C) RDX/SYLGARD INVESTIGATION. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 3p. Dep. NTIS $4.00.

9001 (MHSMP-73-43-F) CHARACTERIZATION OF COLD DRAWING ALUMINUM IN MILD DETONATING FUSE (MDF). Wise, W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 14p. Dep. NTIS $4.00.

Physics and Engineering

9002 (AERE-M-2437(Rev.)) SIMPLIFIED EXPRESSIONS FOR THE POWER OUTPUT OF A LOSSLESS STIRLING ENGINE. Cooke-Yarborough, E. H. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1974. 8p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

9003 (AERE-R-7652) USE OF A FILTER BANK SIGNAL PROCESSOR FOR LASER ANEMOMETRY. Baker, R. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1974. 32p. Dep. NTIS (US Sales Only) $4.75. UK pounds 1.00.

9004 (BDX-613-820(Rev.)) LASER REMOVAL OF DIELECTRIC FROM FLAT CABLES. Horn, R. T. (Bendix Corp., Kansas City, Mo. (USA)). Apr 1974. Contract AT(29-1)-613. 15p. Dep. NTIS $4.00.

9005 (BDX-613-1051(Rev.)) FEASIBILITY OF DRAG SOLDERING. Final Report. Morris, R. S. (Bendix Corp., Kansas City, Mo. (USA)). May 1974. Contract AT(29-1)-613. 11p. Dep NTIS $4.00.

9006 (BDX-613-1113) BEAM LEAD DEVICE AND HYBRID MICROCIRCUIT TESTING. Markley, R. E. (Bendix Corp., Kansas City, Mo. (USA)). [nd]. Contract AT(29-1)-613. 38p. (CONF-740325-1). Dep. NTIS $5.00.
From product testing technology and automation seminar; Kansas City, Missouri, USA (28 Mar 1974).

9007 (BDX-613-1120) MEASUREMENT OF BURRS. Gillespie, L. K. (Bendix Corp., Kansas City, Mo. (USA)). 1973. Contract AT(29-1)-613. 13p. (CONF-740445-3). Dep. NTIS $4.00.
From SME international tool and manufacturing show conference; Philadelphia, Pennsylvania, USA (29 Apr 1974).

9008 (BNL-18752) DESIGN OF DIGITAL FILTERS FOR EXTRACTION OF SIGNALS FROM INTERSYMBOL INTERFERENCE AND NOISE. Nawrocky, R. J.; Kurz, L. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 5p. (CONF-740326-1). Dep. NTIS $4.00.
From eighth annual conference on information sciences and systems; Princeton, New Jersey, USA (25 Mar 1974).

9009 (BNWL-SA-4912) FERROFLUID VARIABLE DENSITY SEPARATIONS. Johnson, J. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 17 Apr 1974. Contract AT(45-1)-1830. 14p. (CONF-740517-2). Dep. NTIS $4.00.
From Northwest Scientific Association annual meeting; Vancouver, B. C., Canada (9 May 1974).

9010 (CEA-CONF-2584) SIGNAL PROCESSING. Max, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1973. 107p. (In French). (CONF-7209114-1). Dep. NTIS (US Sales Only) $8.50.
From conference on metrology in fluid mechanics; Ermenonville, France (24 Sep 1972).

9011 (COO-3120-7) DETECTION OF FAINT IMAGES IN THE PRESENCE OF BRIGHT POINT SOURCES. Technical Report No. 17. Mende, S. B. (Princeton Univ., N. J. (USA). Dept. of Physics). 20 Jul 1973. Contract AT(11-1)-3120. 41p. Dep. NTIS $5.25.

9012 (GKSS-74-E-9) HYDRODYNAMIC FORCES ON OSCILLATING CIRCULAR MEMBERS WITH A PAIR OF TRAILING

VORTICES. Schellin, T. E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Hamburg (F. R. Germany)). 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

9013 (JINR-P4-7709) THEORY OF ACOUSTIC SPIN RESONANCE ON CONDUCTION ELECTRONS. I. Absorbed Power and Line Width. Vlakhov, I. P.; Kalashnikov, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

9014 (KFK-1876) APPLICATION OF THE HEAT PIPE PRINCIPLE TO AVOID THE ERROR DUE TO THE EMERGENT STEM IN LIQUID-IN-GLASS THERMOMETERS. Reiss, F. E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Dec 1973. 30p. (In German). Dep. NTIS (US Sales Only) $4.50.

9015 (LBL-2605) SOME RECENT ADVANCES IN THE THEORY OF CAPILLARY SURFACES. Concus, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1974. Contract W-7405-eng-48. 5p. (CONF-740611-1). Dep. NTIS $4.00.

From 48th national colloid symposium; Austin, Texas, USA (24 Jun 1974).

9016 (LNF-73-65) INSTRUMENTAL TECHNIQUES IN THE OPTICAL MAGNETIC MODULATION SPECTROSCOPY. Montelatici, V. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 7 Nov 1973. 23p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.25.

9017 (ORO-3443-47) SOLUTION OF THE INTERFACE PROBLEM BY HOMOGENIZATION. [Part] II. Babuska, I. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Mar 1974. Contract AT(40-1)-3443. 33p. (BN-787). Dep. NTIS $4.75.

9018 (RT/ING-(74)1) OPTIMUM DIMENSIONING OF CHARGE LOSS DEVICES WITH DIAPHRAGMS FOR LIQUIDS. Tirelli, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan 1974. 16p. (In Italian). Dep. NTIS (US Sales Only) $4.00.

9019 (RT/PROT-(74)2) SOLID SAP: NUMERICAL CALCULATION PROGRAM FOR STATIC STRUCTURE ANALYSIS. Sano, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan 1974. 202p. (In Italian). Dep. NTIS (US Sales Only) $13.25.

9020 (SLA-73-5891) ANALYSIS OF INCOMPRESSIBLE FLOW IN POROUS MEDIA. Shouman, A. R.; Donaldson, A. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 13p. (CONF-740613-3). Dep. NTIS $4.00.

From Heat Transfer and Fluid Mechanics Institute conference; Corvallis, Oregon, USA (12 Jun 1974).

9021 (SLA-74-52) PROTECTIVE CARRIER AND LOADING SYSTEM FOR BEAM LEAD SEMICONDUCTOR DEVICES. Stoner, C. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1974. Contract AT(29-1)-789. 32p. Dep. NTIS $4.75.

9022 (SLA-74-77) EFFECTS OF UNSYMMETRICAL STABILITY DERIVATIVE CHARACTERISTICS AND TRANSVERSE PRODUCTS OF INERTIA ON REENTRY VEHICLE TRIM ANGLE BEHAVIOR. Hodapp, A. E. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1974. Contract AT(29-1)-789. 42p. Dep. NTIS $5.25.

9023 (SLA-74-100) EFFECT OF PHASE NOISE ON THE REAL-TIME ZERO-CROSSING MEASUREMENT OF FREQUENCY. Aronson, E. A. (Sandia Labs., Albuquerque, N. Mex (USA)). Apr 1974. Contract AT(29-1)-789. 17p. Dep. NTIS $4.00.

9024 (SLA-74-196) VACUUM IMPULSE OF COMPRESSED GAS VESSELS. Bennett, M. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). May 1974. Contract AT(29-1)-789. 12p. Dep. NTIS $4.00.

9025 (SLL-73-63) CALCULATION OF INCIPIENT FRACTURE AT A SHRINK-FIT PIN INTERFERENCE. Emery, A. F.; Cupps, F. J. (Sandia Labs., Livermore, Calif. (USA)). May 1974. Contract AT-29-1)-789. 29p. Dep. NTIS $4.50.

9026 (UCID-16461) TRANSIENT CHARACTERISTICS OF THE CONICAL SPIRAL ANTENNA. Landt, J. A.; Miller, E. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Mar 1974. Contract W-7405-eng-48. 114p. Dep NTIS $8.75.

COMPLETE OR PARTIAL COLLECTIONS OF USAEC REPORTS IN COUNTRIES OTHER THAN THE UNITED STATES

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, National Library of Australia
Sutherland, New South Wales Atomic Energy Research Establishment

AUSTRIA
Vienna, International Atomic Energy Agency (IAEA)
Vienna, Zentralbibliothek der Physikalischen Institute der Universität

BELGIUM
Brussels, European Atomic Energy Community (Euratom)
Mol-Donk, Centre d'Etude de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Comissão Nacional de Energia Nuclear
São Paulo, Instituto de Energia Atômica

CANADA
Chalk River, Ontario, Atomic Energy of Canada, Ltd.
Hamilton, Ontario, McMaster University
Ottawa, National Research Council

CONGO, REPUBLIC OF
Kinshasa, Trico Nuclear Center

DENMARK
Risö, Danish Atomic Energy Commission

FINLAND
Otaniemi, Teknillinen Korkeakoulu

FRANCE
Saclay, Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay

GERMANY, WEST
Leopoldshafen, Zentralstelle für Atomkernenergie Dokumentation
Munich, Technische Universität

GREECE
Athens, Nuclear Research Center, Democritus Library

INDIA
Bombay, Trombay, Bhabha Atomic Research Center Library

IRAQ, REPUBLIC OF
Baghdad, Atomic Energy Commission, Nuclear Research Institute

IRELAND
Dublin, University College

ISRAEL
Yavne, Israel Atomic Energy Commission, Soreq Nuclear Research Centre

ITALY
Ispra, Cetis Library
Rome, Centro di Studi Nucleari della Casaccia

JAPAN
Tokyo, National Diet Library
Tokai-Mura, Naka-gun, Ibaraki-ken, Japan Atomic Energy Research Institute

KOREA, REPUBLIC OF
Seoul, Atomic Energy Research Institute

MEXICO
Mexico, D. F., Comisión Nacional de Energía Nuclear

NETHERLANDS, THE
Petten, Reactor Centrum Nederland
The Hague, Bibliothek Octrooiraad

NORWAY
Kjeller, Institutt for Atomenergi

PORTUGAL
Sacavem, Junta de Energia Nuclear

SOUTH AFRICA, REPUBLIC OF
Pretoria, Atomic Energy Board Library

SPAIN
Madrid, Junta de Energía Nuclear, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi Library

SWITZERLAND
Zürich, Swiss Federal Institute of Technology

UNITED KINGDOM
Boston Spa, Wetherby, Yorkshire, British Library Lending Division
Harwell, Didcot, Berkshire, Atomic Energy Research Establishment

IN INTERNATIONAL AGENCIES

EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)
Brussels, Belgium
Ispra, Varese, Italy, Cetis Library

OECD NUCLEAR ENERGY AGENCY (NEA)
British Library Lending Division
Boston Spa, Wetherby, Yorkshire, England

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Vienna, Austria

UNITED STATES
ATOMIC ENERGY COMMISSION
P. O. BOX 62
OAK RIDGE, TENNESSEE 37830
OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U. S. ATOMIC ENERGY COMMISSION

U.S.MAIL

POSTAGE AND FEES PAID
GOVERNMENT PRINTING OFFICE

U.S.MAIL

XEROX UNIVERSITY MICROFILMS 1
SERIALS DEPT.
300 N. ZEEB ROAD
ANN ARBOR, MI 48106

Announcing the publication of

Nuclear Power Reactor Instrumentation Systems Handbook

Volume 2

Editors
Joseph M. Harrer, Argonne National Laboratory
James G. Beckerley, U. S. Atomic Energy Commission

This handbook is for designers and operators of power-reactor instrumentation systems and those concerned with application and not with invention. The accepted practices used in the design of nuclear reactor instrumentation systems are covered, and the systems used on today's power reactors are described. In some cases the plants discussed are still in the design stage. The requirements (or design bases) to be satisfied by each system and subsystem are given first: then the current practices are outlined and evaluated.

This volume covers applications and includes material on plant protection, standards, and radiation monitoring, and descriptions of four plant designs: BWR, PWR, and sodium- and gas-cooled reactors. The basic data on neutron sensors, kinetics, computers, process sensors, rod drives, power supplies, installation methods, and quality assurance and reliability are discussed in Volume 1.

Available as TID-25952-P2 for $7.60 from

National Technical Information Service
U. S. Department of Commerce
Springfield, Virginia 22151

May 1974
280 pages, 8½ by 11 inches
International Standard Book Number 0-87079-005-6
Library of Congress Catalog Card Number 72-600355